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WASTEWATER ENGINEERING AND MANAGEMENT PLAN FOR BOSTON HARBOR - --ETC(U)
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WASTEWATER ENGINEERING AND MANAGEMENT PLAN

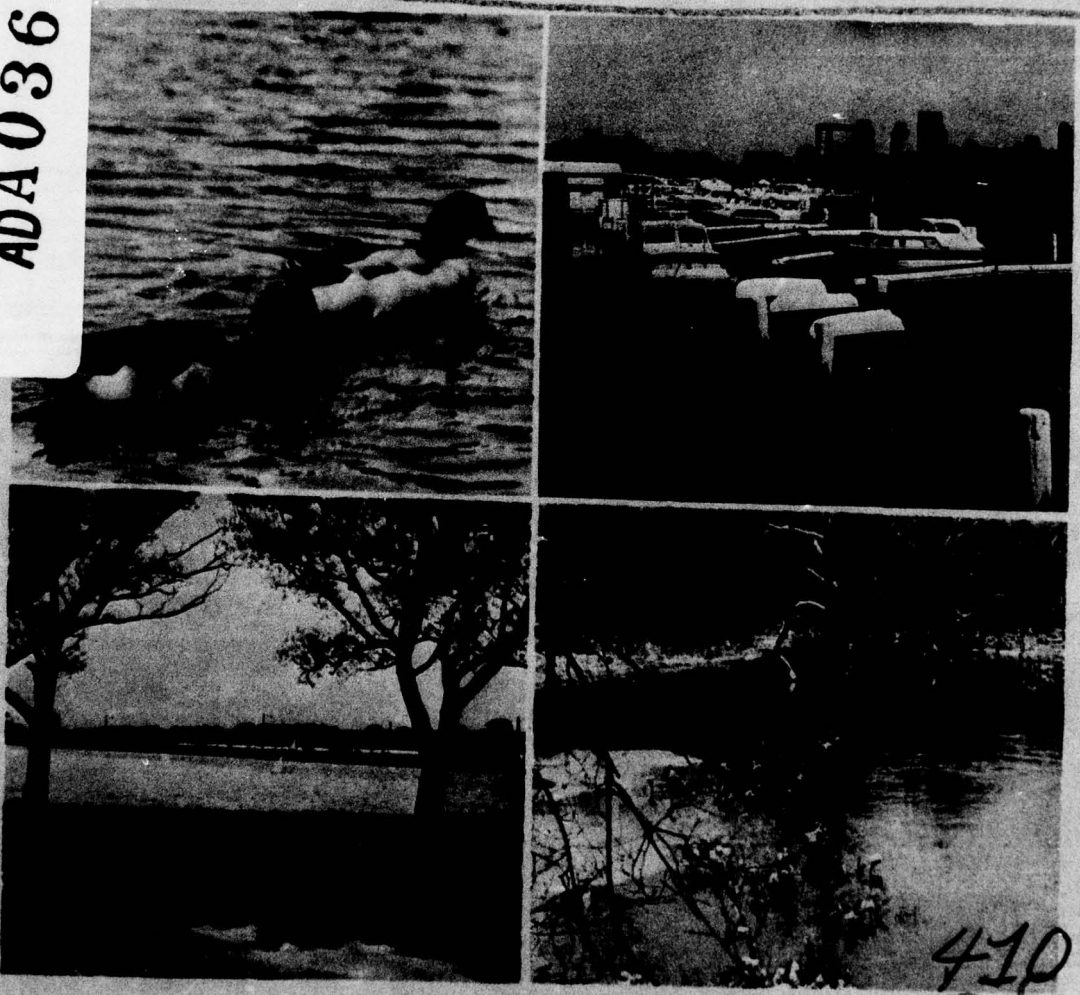
FOR

BOSTON HARBOR - EASTERN MASSACHUSETTS METROPOLITAN AREA

EMMA STUDY.

TECHNICAL DATA [redacted] olume 13.

IMPACT ANALYSIS AND EVALUATION.



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144p.

EMMA STUDY - IMPACT ANALYSIS AND EVALUATION VOL. 13

WASTEWATER ENGINEERING
AND MANAGEMENT PLAN
FOR
Boston Harbor - Eastern Massachusetts Metropolitan Area
EMMA STUDY

INDEX TO REPORT VOLUMES

Technical Data Volume 13

Impact Analysis and Evaluation

Eastern Massachusetts Metropolitan Area

Wastewater Management Study

Prepared by

U.S. Army Engineer Division, New England
Waltham, Massachusetts

TECHNICAL DATA VOLUME 13
IMPACT ANALYSIS AND EVALUATION

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APPENDICES

A. INTRODUCTION

The main objective of the Boston Habor-Eastern Massachusetts Metropolitan Area Wastewater Management Study (BH-EMMA) is to determine the future size of the Metropolitan Sewerage District and to propose and evaluate alternative wastewater management systems for study area communities in accordance with goals, objectives, and requirements of Section 201 of the 1972 Water Pollution Control Act Amendments (Public Law 92-500).

The Eastern Massachusetts metropolitan area is defined as 109 cities and towns within a 30-mile radius of the City of Boston. In recent years, this area has experienced rapid population and industrial growth in outlying suburbs. Growth in suburbs has led to increased pollution of major tributaries to Boston Harbor - the Charles, Neponset and Mystic Rivers - by faulty on-lot sewage disposal systems, stormwater runoff, inadequate waste treatment facilities and industrial wastes. Both improvement and expansion of existing waste treatment systems and implementation of new waste treatment systems are needed to control and mitigate the effects of this increased pollution load.

Section 201 of Public Law 92-500 requires that plans for waste treatment facilities be coordinated with areawide waste treatment management plans, authorized under Section 208 of Public Law 92-500, consider alternative waste treatment management techniques to provide application of best practicable waste treatment technology to all municipal facility discharges, and identify the economic, social and environmental impacts of carrying out each of these alternatives.

The BH-EMMA study developed six alternatives for wastewater management in the study area: 4 water-oriented alternatives, 1 land-oriented alternative, and a Recommended Plan (also a water-oriented alternative). All these alternatives provide a minimum of best practicable treatment. The plan recommended by the study will be coordinated with areawide waste treatment management plans currently being developed by the Metropolitan Area Planning Council.

This Volume documents the New England Division of the Corps of Engineers impact assessment effort as a part of the development of alternatives for the BH-EMMA study area. It shows how the study's Technical Subcommittee, consisting of representatives of the Massachusetts Division of Water Pollution Control, Metropolitan District Commission, Office of State Planning, Department of Public Health, Metropolitan Area Planning Council, Corps of Engineers, Environmental Protection Agency and a Citizens' Committee, considered both beneficial and adverse aesthetic, biological, hygienic and socio-economic impacts that would result from the various proposed alternatives for wastewater management within the BH-EMMA study area.

The first portion of this report sets forth the definition and basis for impact assessment in the planning process. The Water Resources Council's Principles and Standards, which establishes a framework for formulation and evaluation of Federal water and related land resources projects, and requires that in such projects, environmental concerns be placed on an equal basis with economic development, are presented.

Next the report shows the relationship between tasks performed by the BH-EMMA study team and tasks specified in Principles and Standards. Identification of study goals and objectives; input of study goals into the development of wastewater management alternatives; the Corps of Engineers effort in impact analysis; the role of the public participation in the impact assessment process; and problems related to the study's conformance with Public Law 92-500 are discussed.

Finally, a summary of the various impact analyses, and an evaluation of impacts in relation to both study and Federal goals and objectives is provided. Results of impact analyses performed for this study will be used as input to the final Environmental Impact Statement for the study's Recommended Plan, which is to be completed before implementation of recommended projects.

B. DEFINITION OF IMPACT ASSESSMENT

Impact assessment may be defined as the analysis and evaluation of change resulting from the implementation of a specified "plan action", or component of an alternative engineering system.

Impact analysis is the measurement of the change against a base-line condition. It involves categorization and identification of significant environmental, economic, and social changes; identification of duration of these changes; and measurement of the magnitude of these changes.

Impact evaluation is the determination of change as beneficial, adverse or neutral (and making trade-offs amongst these changes) in accordance with community goals and objectives as well as with the Federal objectives, expressed in the Water Resource Council's Principles and Standards, of National Economic Development, Environmental Quality, Social Well-Being and Regional Development.

Impact analysis and evaluation cannot be expected to make decisions; it is one of the many "tools" in the decision-making process. However, it can be expected to give meaningful insight into the consequences of each proposed action, and to point out areas of concern. It can surface information that is useful in the modification of alternative plans to more fully address planning objectives by maximizing beneficial effects and minimizing adverse consequences. If adverse consequences cannot be avoided, impact assessment may surface mitigation measures to lessen their intensity.

The entire impact assessment process should be integrated with other planning tasks (mentioned in Section D) and a meaningful public involvement program to obtain continuous public opinion on planning data, assumptions and alternatives.

C. BASIS FOR IMPACT ASSESSMENT

Impact assessment is needed (1) to satisfy requirements of Federal and State law, and (2) to simplify the planning process, so that adverse and beneficial effects of alternative plans may be readily identified by the planner and made comprehensible to the general public.

An increasing concern over the impact of man's activities on our environmental resources has led to several Federal legislative actions requiring the development of alternative plans for resource management projects, and the assessment of both beneficial and adverse effects that would result from the implementation of each resource management alternative. Some of these enactments are discussed below:

The Water Resources Planning Act of 1965 (Public Law 89-90) establishes a comprehensive planning approach to conservation, development, and use of water and related land resources. This Act creates the Water Resources Council and empowers this Council to establish principles and standards for Federal participation in the preparation of comprehensive regional and river basin plans, and for formulation and evaluation of Federal water and related land resources projects. These Principles and Standards, established in September 1973, place environmental concerns on an equal basis with economic development, allowing planners to realize the environmental trade-offs in resource planning. They also require recognition of adverse and beneficial effects of resource management plans on regional development and social well-being.

The National Environmental Policy Act of 1969 (Public Law 91-190), with its goal to ensure the systematic consideration of environmental amenities and values in the Federal decision-making process, requires that each Federal agency prepare an environmental impact statement in advance of each major action, recommendation, or report on legislation that may significantly affect the quality of the human environment.

Section 122 of the River & Harbor and Flood Control Act of 1970 (Public Law 91-611) requires the promulgation of guidelines designed to assure that possibilities of adverse economic, social and environmental effects or impacts have been fully considered in developing water and related land resource projects. Section 209 of the same act states that it is the intent of Congress that enhancement of regional economic development, environmental quality, social well-being and national economic development are to be objectives of Federally financed water resources projects. These objectives are to be recognized in the evaluation of benefits and costs attributable to such projects, to arrive at the most feasible alternative means of accomplishing them.

Finally, Section 201 of the Water Pollution Control Act Amendments of 1972 (Public Law 92-500) states that the Administrator of the Environmental Protection Agency shall not make grants for wastewater treatment works for any fiscal year beginning after June 30, 1974

unless the grant applicant has satisfactorily shown the Administrator that alternative waste management techniques have been studied and evaluated. Sections 208 and 303e require that plans prepared in accordance with the areawide waste treatment management process contain alternatives for waste treatment management, and identification of economic, social and environmental impacts of carrying out a plan within a specified time period.

In addition, the State of Massachusetts, through Chapter 30, Section 61 of the General Laws, requires environmental impact assessment of all works, projects or activities of state agencies and state and local authorities which may cause significant environmental damage. The Section defines environmental damage as "significant actual or probable destruction, damage or impairment to the natural resources and historic sites of the Commonwealth." All state agency decisions shall include findings which describe environmental impact and state that all feasible measures have been taken to avoid or minimize adverse impact.

Aside from satisfying requirements of Federal and State law, impact assessment is a useful planning tool as it allows planners to identify plan actions which are most responsive to study objectives and Federal goals. It is also a useful tool in the public involvement program as it presents information in a form that can be easily understood and evaluated by the general public.

It must be remembered that impact assessment is a new task in the decision-making process. A standard methodology for performance of this task is still in a developmental stage. One of the biggest problems encountered in this task is the comparison of qualitative and quantitative changes or impacts. Most environmental and social impacts can only be described or measured qualitatively. Comparison of these impacts with quantitative economic impacts, such as Capital and Operation & Maintenance costs of new facilities, is quite difficult and often leads to a bias towards plans with the lowest dollar cost. Methods must be developed to transform qualitative environmental impacts into dollar values before a sound impact assessment can be made.

Nevertheless, recognition of the need for consideration of both environmental and economic impacts on an equal basis is an enlightening breakthrough for the planning process.

D. IMPACT ASSESSMENT - AN INTEGRAL PART OF THE PLANNING PROCESS

1. Plan Development Stages

Principles and Standards for Planning Water and Related Land Resources requires that plans for resource management be developed in three stages:

a. Plan of study

b. Intermediate plans

c. Detailed plans

Four functional planning tasks are to be performed at least once, and maybe repeated several times, during each stage. These tasks are:

a. Problem Identification

b. Formulation of Alternative Plans

c. Impact Analysis

d. Impact Evaluation

During the Plan of Study, the four planning tasks are to be performed at a preliminary level to define the scope and character of the study. Emphasis at this stage is primarily given to identification of resource management issues and development of broad planning objectives. In addition, preliminary impact analysis and evaluation is to be carried out. Emphasis at this stage must also be placed on determination of management of the overall study effort.

In the Intermediate Stage, emphasis is to be placed on characterization of ways to achieve planning objectives. Alternatives are to be outlined and defined without consideration of detailed engineering plans; and potential impacts are to be assessed. Impact assessment should be definitive enough to identify major changes from the base condition by developing a detailed information base and alternative plans to it.

During the development of Detailed Plans, emphasis is to be placed on modifying and reducing the number of alternatives to produce an array of feasible plans. Specific data is needed at this stage for detailed design and impact assessment.

2. Planning Tasks

The four planning tasks are described in greater detail below:

a. Problem Identification

This task involves identification of public concerns through review of recent Federal and State legislative actions; Federal and State policies and goals; as well as through public feedback obtained through a public participation program involving both the general public and special interest groups. These public concerns must be related to problems that can be solved by resource management. The study area must be defined through evaluation of these public concerns related to resource management. In most instances, the study area will correspond with the area specified in the study authority.

Following identification of the study area, a base condition must be defined in environmental, economic and social terms. Existing programs for planning and managing resources, and existing institutions dealing with resource management in the study area must also be identified.

After base conditions are defined, alternative future conditions in the study area should be projected. Various future conditions will depend on different courses of action to be followed. One necessary component of projecting alternative futures is to describe what would most likely happen without changing existing programs for resource management - the "without" or "no action" condition. Finally, the planning objectives are derived by analyzing alternative futures in relation to the without condition.

b. Formulation of Alternatives

This task provides for development of resource management systems to achieve the planning objectives. It involves identification of both structural and non-structural technical and institutional measures for managing resources. (Non-structural measures are actions not dependent upon extensive construction activities). These structural and non-structural measures should be categorized by identifying those which contribute to a number of objectives, and those which contribute to only one objective. Then alternative plans are to be formulated by linking or combining the different measures into complete management systems.

A number of different types of alternative plans should be considered. As a minimum, a plan maximizing a goal of National Economic Development and a plan maximizing a goal of Environmental Quality must be identified. The goal of National Economic Development will emphasize net economic benefits, while an Environmental Quality goal will emphasize contributions to aesthetic, ecological and cultural values. Finally, plans of other Federal, State and local agencies must be reviewed and considered in the formulation of plans.

c. Impact Analysis

Impact analysis involves the identification of types of impacts (economic, social, environmental, etc.), the incidence of these impacts and measurement of the magnitude of these impacts.

Analysis of impacts forms the basis for evaluating beneficial and adverse contributions of each plan.

d. Impact Evaluation

Impact evaluation enables the determination of both beneficial and adverse effects of each alternative plan in accordance with community goals and objectives as well as with the Federal objectives expressed in the Water Resource Council's Principles and Standards.

The first step in this process is to determine whether the impacts of each plan contribute beneficially or adversely to both the planning objectives and the Federal objectives expressed in the Water Resource Council's Principles and Standards. The plans which maximize criteria of National Economic Development and Environmental Quality should be identified. Contributions of the alternative plans to Federal interest and other Federal evaluation criteria must be determined.

Federal interest in the different plans is to be determined by summing economic and environmental benefits of each plan and comparing them with the sum of economic and environmental costs of each plan.

Finally, a trade-off analysis is to be conducted to analyze comparative contributions of the alternative plans. The result of this trade-off analysis will be the basis for additional iterations of these four planning tasks.

Planning procedures followed by this study did not adhere to all practices recommended by Principles and Standards, as the study began before their final publication. However, there is a great amount of similarity between the two-planning procedures. An attempt is made on the following pages to relate the planning tasks in the Boston Harbor-Eastern Massachusetts Metropolitan Area study to those set forth by Principles and Standards and to point out the study's achievements and difficulties.

E. IDENTIFICATION OF ISSUES, NEEDS AND OBJECTIVES

The initial planning task, Problem Identification, is the pivotal task on which the planning process is based. This task first involves surveying available sources of information to tentatively identify the range of problems and concerns a study could address. These concerns should be elicited through:

(1) consultation with government agencies involved in the study, and review of Federal and state policies and objectives, and

(2) a public involvement program in which all areas of the general public participate.

Conferences and studies completed prior to the BH-EMMA Study identified the many water pollution and wastewater management problems in the Boston Harbor-Eastern Massachusetts area. In the fall of 1972, the members of the technical subcommittee of the Boston Harbor-Eastern Massachusetts Metropolitan Area study, were asked to recommend study goals and objectives needed to address these various problems. Goals are far reaching and long term in nature, while objectives are more exact and are set out in measurable quantities with definite long or short term deadlines. The recommended goals and objectives may be grouped into three categories: national goals and objectives, specific study objectives, and regional goals and objectives.

1. National Goals and Objectives

The U.S. Environmental Protection Agency recommended that the study address national goals set forth in the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). The objective is this Act is to "restore and maintain the chemical, physical and biological integrity of the nation's waters." To achieve this objective, the law states two goals:

(1) To achieve, wherever possible by July 1, 1983, water quality which provides for the protection and propogation of fish, shellfish and wildlife, and provides for recreation in and on the water.

(2) To eliminate, by 1985, discharge of pollutants into all navigable waters.

It was further recommended by the Environmental Protection Agency that the study develop specific conclusions and recommendations for actions, and lead to the implementation of wastewater management plans that will:

a. Meet water quality standards by 1977 throughout the study area.

b. Achieve wherever attainable a water quality sufficient for recreation in and on the water as well as propogation of fish, shellfish and wildlife by 1983.

c. Encourage solutions that will lead to the elimination of pollutants and stress wastewater reuse and renovation.

d. Result in preliminary plans and engineering studies meeting the requirements of Section 201 of Public Law 92-500 (See Appendix A).

The U.S. Army Corps of Engineers, recognizing Public Law 92-500's goal to eliminate discharge of pollutants into navigable waters by 1985, recommended that "thorough elimination of pollutants" be a study objective.

2. Regional Objectives

The regional goals and objectives submitted by the Metropolitan Area Planning Council, may be grouped into four categories: Housing, Economic, Environmental, and Transportation. These goals, described below, were not entirely incorporated into Boston Harbor-Eastern Massachusetts Metropolitan Area study goals as they are not related to water quality and waste management. Objectives and policies connected with each of these goals are presented in Appendix B.

a. Housing - "A decent home and a healthy living environment for every resident of the Metropolitan Boston Region."

b. Economic - "Assurance of the economic well-being of all the residents by maintaining and enhancing the economic competitive position of the Metropolitan Boston Area in relation to the national economy and providing for an efficient geographic distribution of employment throughout the region."

c. Environmental - "Establishment of a physical environment that is well ordered, efficient, varied as to man-made and natural features, and meets the aesthetic, health, and recreation needs of all citizens."

d. Transportation - "Provide for the safe, convenient travel of the general public by means of integrated, intermodel transportation systems."

In addition to their input to the development of study objectives these regional goals, developed by Metropolitan Area Planning Council, were used as input to the EMPIRIC Land Use Allocation Model used to develop small area projections of population, employment and land use for the study area for the years 2000, 2020, and 2050. Other inputs to the model were current data on population, employment, land use,

water and sewer use, transportation, major centers, and interdistrict distances. This data constituted the initial baseline condition. The models projections were used to further define the study area by designating high priority areas, and to estimate future wastewater contributions and needs in the Eastern Massachusetts Metropolitan Area.

3. Study Objectives

The specific study objectives developed by the Metropolitan District Commission and later accepted by the Technical Subcommittee are generally in accordance with Section 201 of the Act. They are as follows:

a. To develop recommendations for the management of wastewater in Eastern Massachusetts up to the year 2050.

b. To determine the ultimate growth or contraction of the Metropolitan Sewerage District (MSD) to the year 2050. All engineering, economic, and environmental aspects to be considered, including the river basin concept.

c. To make recommendations for a management organization for the MSD and its subregional districts as may be projected. Administrative structure, policies, financial arrangements, and related management matters to be considered.

d. To determine facilities required for the collection, treatment, and disposal of existing and future MSD sewage flows including the preparation of preliminary engineering designs for the recommended method of treatment for the Deer Island and Nut Island projected sewage flows.

e. To make recommendations for the regulation of combined sewage overflows, infiltration and storm water with respect to both the MSD system and the systems of its member communities.

f. To undertake an industrial waste survey and inventory including developing industrial waste regulations and an equitable cost recovery system.

g. To determine the feasibility of reclamation and reuse of wastewater and treated water.

h. To develop short-range construction programs and detailed plans for facilities required by the year 2000.

i. To develop a public participation program throughout the duration of the study.

j. To meet the requirements of Section 201 of Public Law 92-500.

These goals and objectives and projections obtained from the EMPERIC Model were used to develop alternative plans to "no action". These alternative plans were essentially ways to improve wastewater management in Eastern Massachusetts.

They were:

a. Make improvements in only the existing Metropolitan Sewerage District.

b. Expand the district by 16 communities or delete some outlying communities.

c. Expand the district to include all 109 communities in the study area.

d. Eliminate the district and create a decentralized system with satellite facilities.

4. Citizens Input to Study Goals

In October 1973, the study established a Citizens Committee to act as a sounding board for alternative engineering plans and the public involvement program. The committee also participated in technical subcommittee meetings and encouraged public response.

In November 1973, the Boston Harbor-Eastern Massachusetts Metropolitan Area study held its first series of public meetings. The purpose of these meetings was to provide background information on the study; to explain the public participation program; to present study goals and objectives, and inputs and outputs of the EMPIRIC Model used to develop alternative plans for wastewater management; and to explain work being done by the study group to accomplish its goals and objectives.

The public was asked to provide input to all topics discussed at the public meeting. Comments and questions appeared to fall into four major categories:

a. Concern over how study projections and planning assumptions would effect local life styles. Many people expressed a preference for continued reliance on low density development, accompanied by on-site wastewater disposal systems, and favored land use controls over construction of wastewater treatment facilities.

b. Concern over water supply and its relation to wastewater management and disposal.

c. Concern over incorporation of new technologies in the study. Many questions were asked concerning efficiency of secondary and advanced treatment, the feasibility of land treatment, recycling

of wastewater and use of alternative sources of energy, such as generation of energy from sludge.

d. Concern over management and funding alternatives and the purpose of the study and its relation to other resource management studies in the area. There was apprehension that the study results would dictate what areas would be sewered, put a moratorium on current plans for new treatment facility construction, and force towns to join the Metropolitan Sewerage District.

In summary, the study goals concerning (1) reuse and reclamation of wastewater, and (2) development of wastewater management plans on an areawide basis, elicited the most response. There were few comments directed toward other study goals concerning water quality or level of treatment. This may have been due to the general public's unfamiliarity with the technical aspects of water pollution and wastewater management. Lack of response to other goals and the projections of the EMPIRIC Model also may have been caused by the public's unfamiliarity with the study and the public participation process.

Public input increased as the study progressed.

F. DEVELOPMENT OF ALTERNATIVE CONCEPTS

Four water-oriented alternative concepts for wastewater management in the Boston Harbor-Eastern Massachusetts Metropolitan Area were developed by engineering consultants to the Metropolitan District Commission. These alternatives addressed the four plans to improve wastewater management developed to meet the needs projected from the output (population, employment and land use) of the EMPIRIC Model.

In addition, the Army Corps of Engineers, recognizing Public Law 92-500's encouragement of waste treatment management which results in recycling of potential sewage pollutants, contracted a consultant to develop a land-oriented concept. Due to lack of available and suitable land within the study area, most proposed land application sites were located outside the Boston Harbor-Eastern Massachusetts Metropolitan Area.

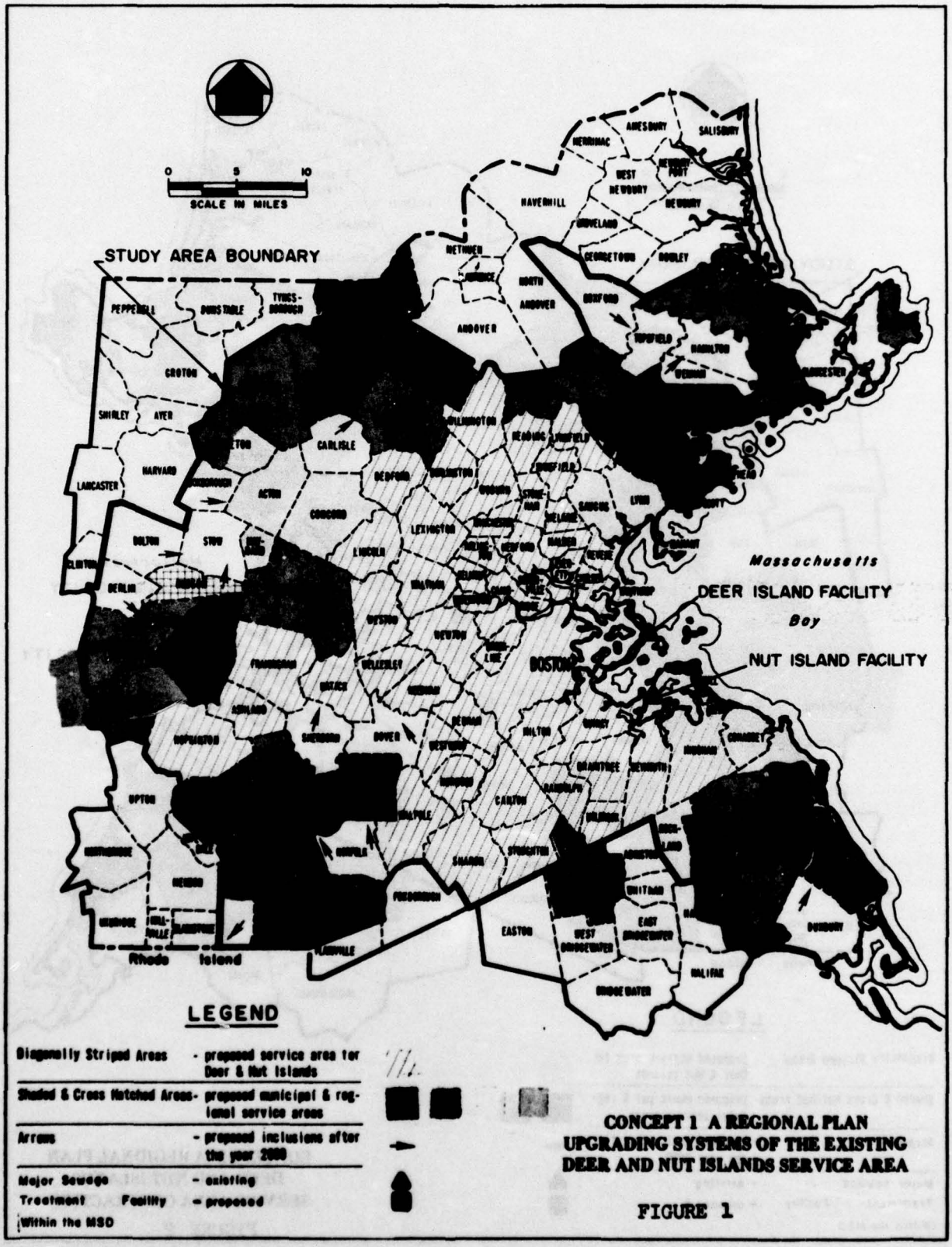
Both water-oriented and land-oriented alternatives are shown in Figures 1 through 5. Further description of these alternative concepts is provided in Technical Data Volumes 4 and 5. All concepts incorporated treatment facilities proposed by the State-EPA implementation plan in areas where such a plan exists. A map of both existing facilities and facilities proposed by the State-EPA Implementation Plan is given in Appendix C.

Secondary treatment was proposed for coastal facilities and advanced treatment was proposed for facilities discharging to inland waters. However, in the land-oriented concept, secondary treatment was proposed for inland facilities participating in the land application system. A flow chart of treatment processes is given in Figure 6.

The Army Corps of Engineers contracted 4 separate consultants to perform biological, socio-economic, hygienic, and aesthetic impact assessment on these five alternative plans. Preliminary impact assessments were published in the Information Packet for Mid-Stage Public Meetings (See Appendix D). This information packet was available to all citizens on the mailing list for the study's public involvement program before the mid-stage meetings in May 1974.

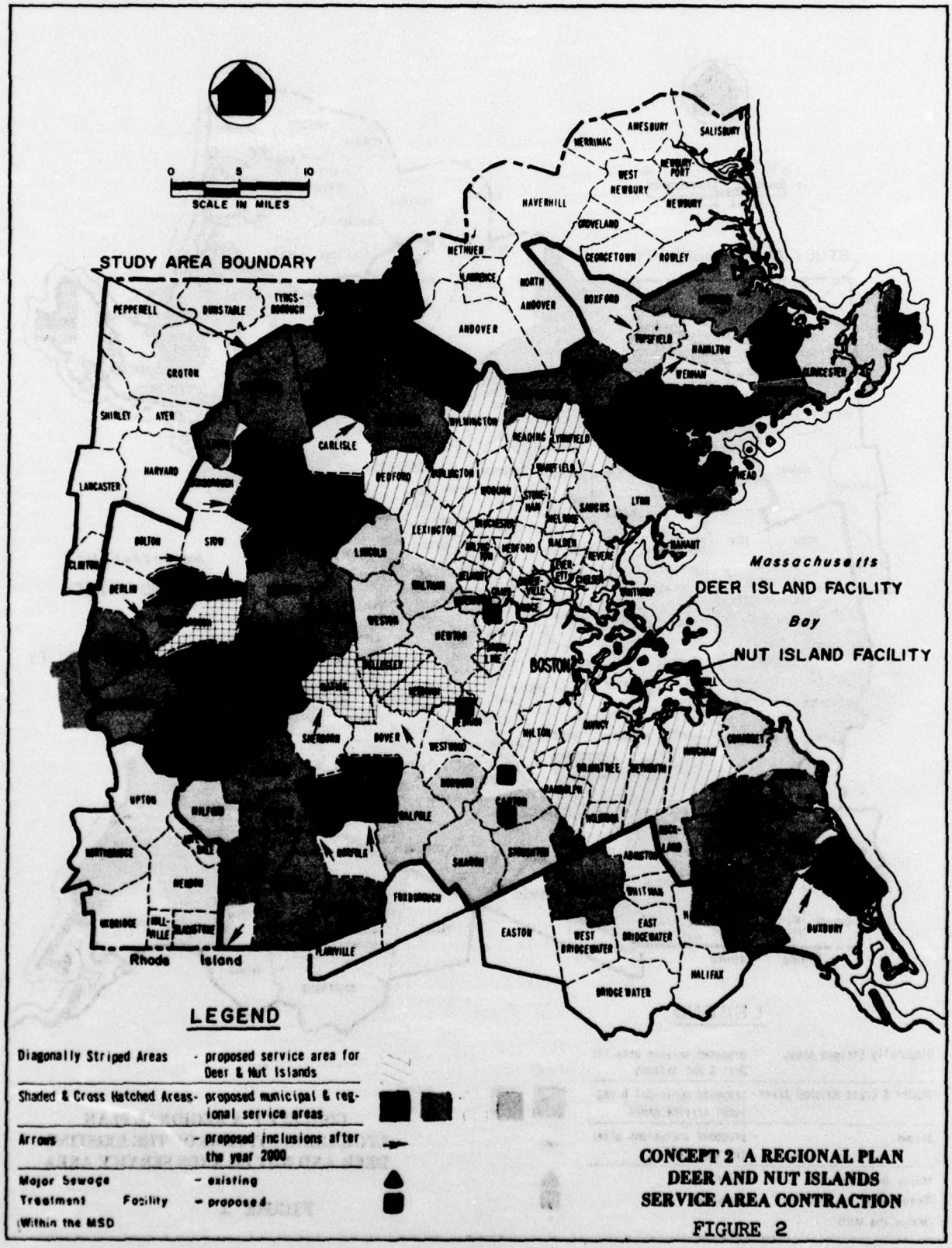
At these meetings, the five alternative concepts for wastewater management were presented along with preliminary cost estimates and impact assessments. Major public response fell into the following categories:

1. Concern over the maintenance of river basin integrity and assurance of an adequate supply of water within each basin. Concepts 2 and 4 were favored because of their decentralized approach to wastewater management which returns treated wastewater to its basin of origin.



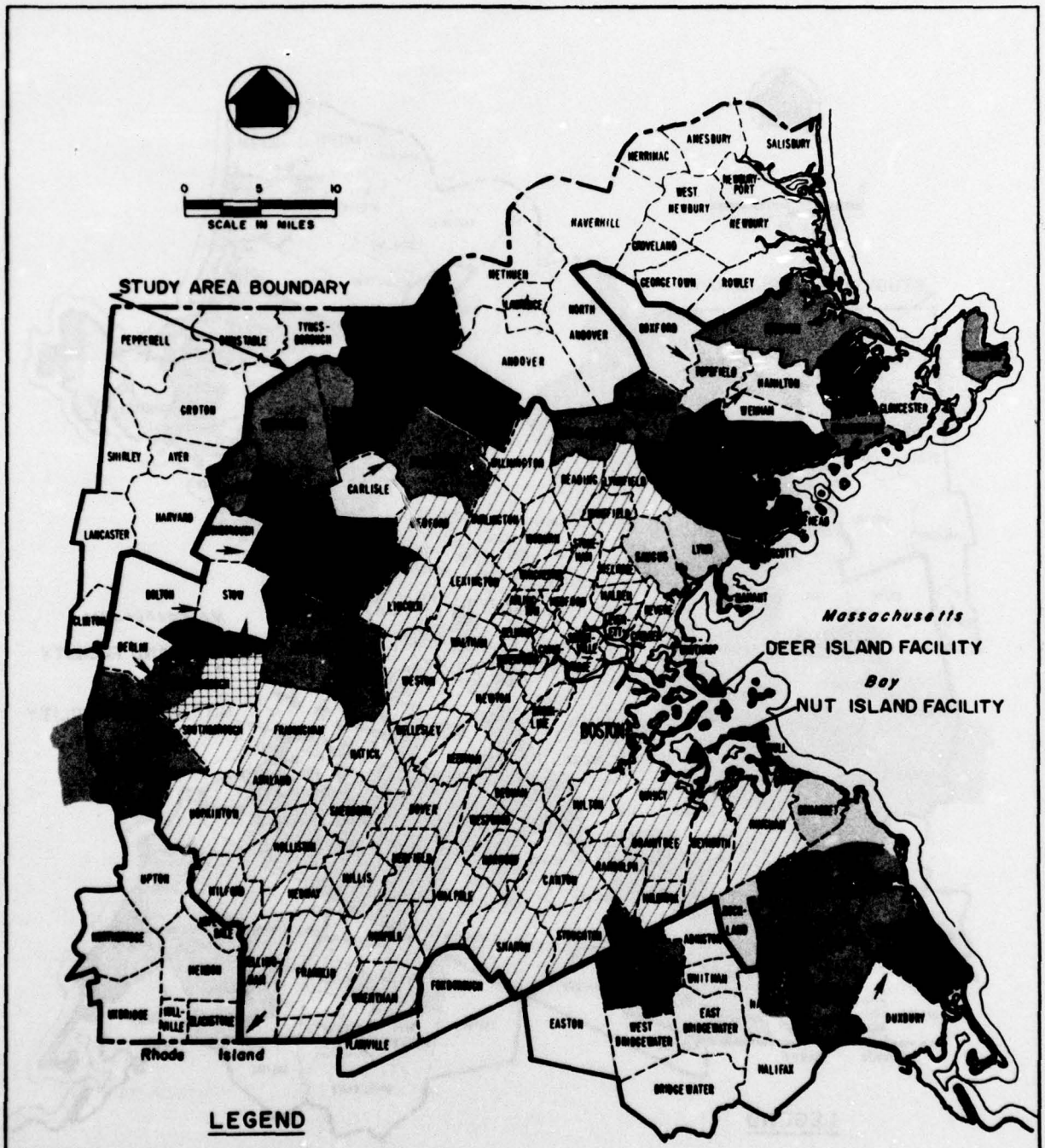
CONCEPT 1 A REGIONAL PLAN UPGRADING SYSTEMS OF THE EXISTING DEER AND NUT ISLANDS SERVICE AREA

FIGURE 1



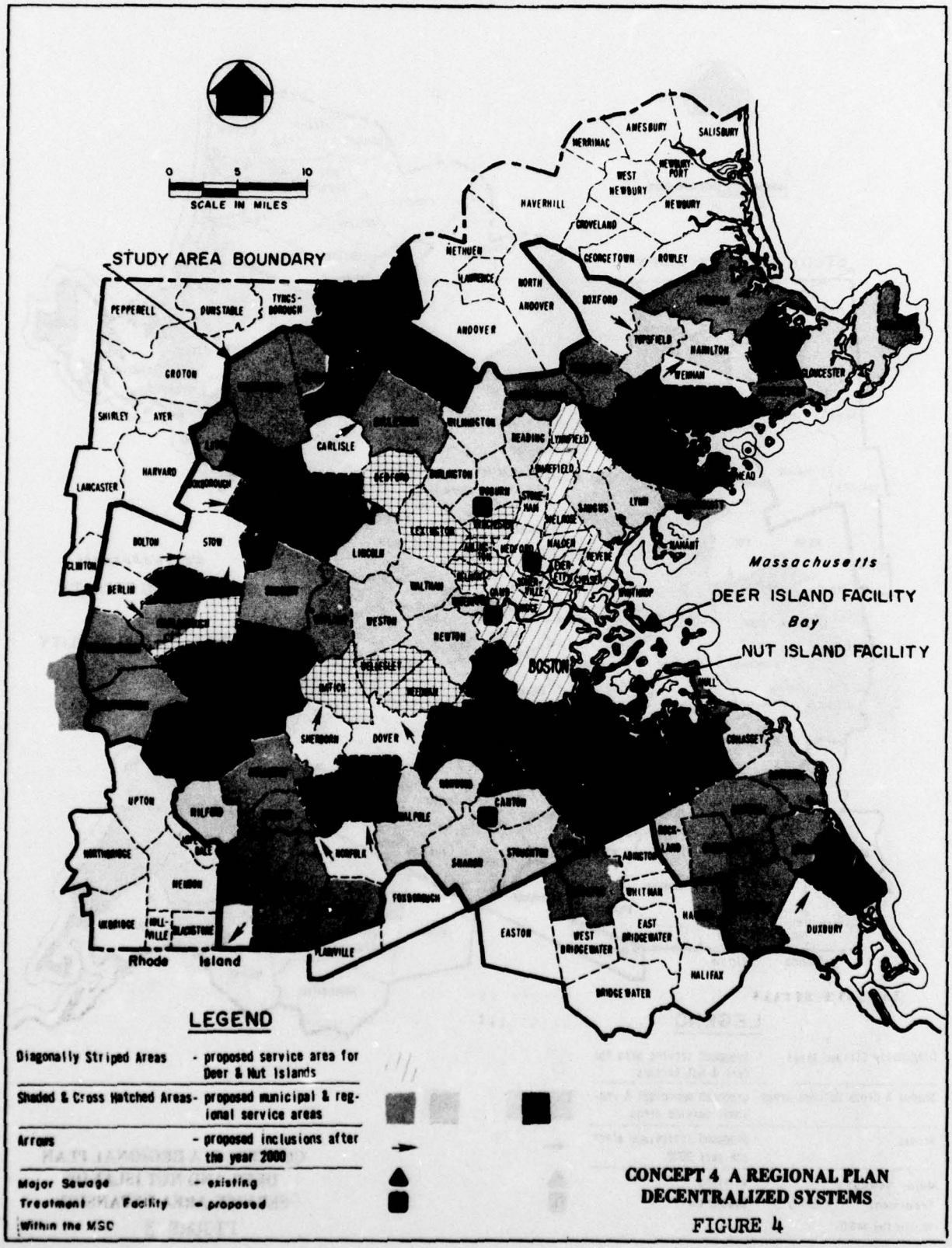
CONCEPT 2 A REGIONAL PLAN DEER AND NUT ISLANDS SERVICE AREA CONTRACTION

FIGURE 2



CONCEPT 3 A REGIONAL PLAN
DEER AND NUT ISLANDS
SERVICE AREA EXPANSION

FIGURE 3



CONCEPT 4 A REGIONAL PLAN DECENTRALIZED SYSTEMS

FIGURE 4

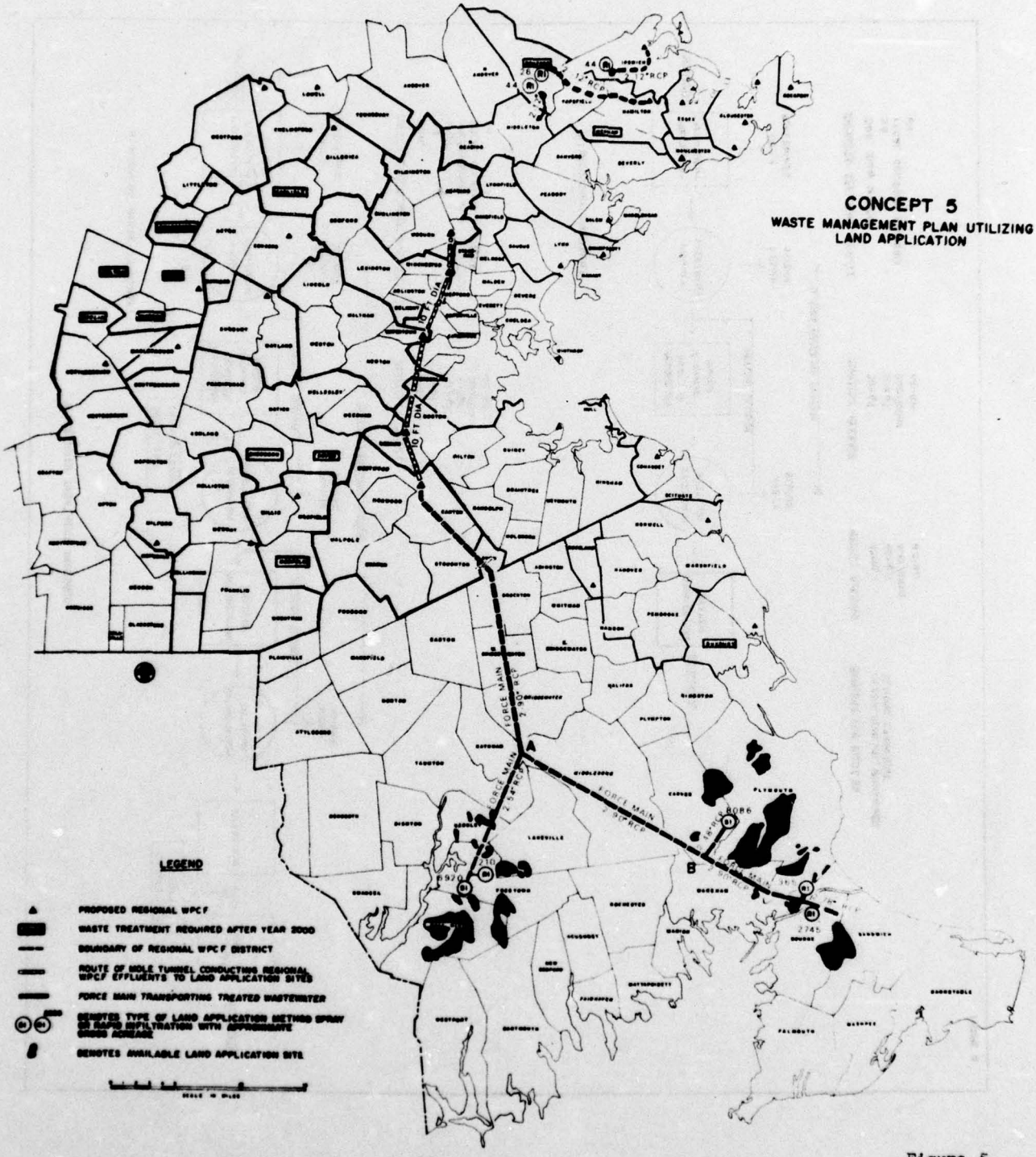
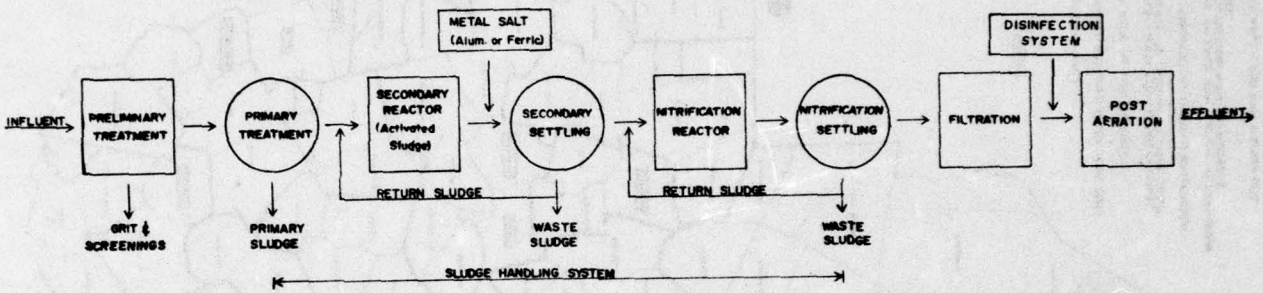

CONCEPT 5
WASTE MANAGEMENT PLAN UTILIZING
LAND APPLICATION
LEGEND
PROPOSED REGIONAL WPCF
WASTE TREATMENT REQUIRED AFTER YEAR 2000
BOUNDARY OF REGIONAL WPCF DISTRICT
ROUTE OF HOLE TUNNEL CONDUCTING REGIONAL WPCF EFFLUENTS TO LAND APPLICATION SITES
FORCE MAIN TRANSPORTING TREATED WASTEWATER
DENOTES TYPE OF LAND APPLICATION METHOD SPRAY OR RAPID INFILTRATION WITH APPROXIMATE GROSS ACREAGE
DENOTES AVAILABLE LAND APPLICATION SITE
10 FT DIA
FORCE MAIN
FORCE MAIN
FORCE MAIN
FORCE MAIN
2745

Figure 5

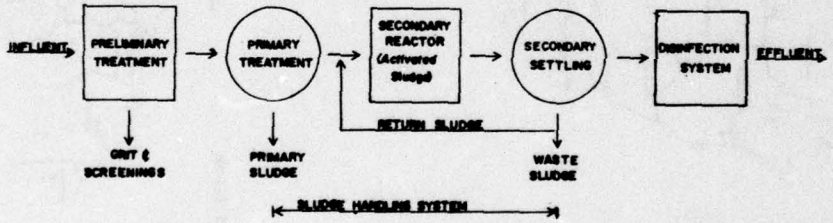
WASTEWATER TREATMENT PROPOSED

a.) ADVANCED WASTE TREATMENT



EXPECTED EFFLUENT QUALITY	MONTHLY AVERAGE
BOD_5	5mg/l
S.S.	5mg/l
NH_3-N	<1 mg/l
PHOSPHORUS AS P	<1mg/l
FECAL COLIFORM BACTERIA	200/100ml
pH	6.0-9.0

b.) SECONDARY TREATMENT



EXPECTED EFFLUENT QUALITY	MONTHLY AVERAGE	WEEKLY AVERAGE	REMARKS FOR B.O.D & S.S
BOD (5 day at 20°C)	30mg/l	45mg/l	OR 85% REMOVAL, WHICHEVER IS MORE STRINGENT
S.S.	30mg/l	45mg/l	
FECAL COLIFORM BACTERIA	200/100ml	400/100ml	
pH	6.0-9.0	6.0-9.0	

FIGURE 6

2. Interest in the feasibility, reliability, health impacts and costs of the land-oriented concept (Concept 5).

3. Again, a preference for low density development accompanied by a continued reliance on individual on-lot disposal systems as an alternative to construction of wastewater facilities in outlying areas.

4. Concern over the costs and management of each alternative and their effects on individual towns and subregions.

5. Minor concern over degree of treatment and effects of treatment facility effluent on water quality.

In summary the public showed interest in obtaining more information on land treatment and a preference for a decentralized approach to wastewater management. Public preference for decentralization was an important factor in the decision-making process.

G. IMPACT ANALYSIS

1. Impact Analysis in the Planning Process

After the series of mid-stage public meetings, the public's response to the study's proposed alternatives increased as citizens and officials in southeastern Massachusetts voiced their disapproval of Concept 5. The Corps of Engineers met with selectmen and the Department of Public Works officials from various towns in this area to clarify the land-oriented concept; however, the response was still negative largely due to apprehension over public health hazards, and the concept's lack of local benefits. This response ultimately led to the Technical Subcommittee's rejection of Concept 5.

At the same time, draft impact analyses were completed by consultants and distributed to the technical subcommittee for review. A summary of these assessments and explanation of assessment procedures is given in Section G (2). Most impact analyses favored Concept 1 with modifications. This preference was not based on the concept's superiority in positive impacts, but on its comparative lack of negative impacts. After considering both public response and consultant's impact analyses the Technical Subcommittee was asked to rate each concept on twenty-three factors. These factors, proposed by engineering and impact consultants, are listed on the Rating Form (Figure 7). Each factor was weighted for importance (a weighting of (1) would be the most important). The concepts were then ranked on a scale of one to five against each factor. The rank given each concept by factor was multiplied by the weight assigned to the factor. The weighted rankings were summed. The lower the total, the more favorable the concept. Results of his rating exercise are also shown in Figure 7. Concept 1 ranked most favorable, followed by 4, 2, 3 and 5. These results were sent out to citizens in a Progress Report on the Boston Harbor-Eastern Massachusetts Metropolitan Area Study in November 1974. This Progress Report requested that citizens respond to the results of the rating exercise and voice their preference for one of the five engineering alternatives. Again, response was largely in favor of a decentralized concept.

Results of the rating exercise were also presented at a meeting of the Technical Subcommittee in December. The purpose of this meeting was to select the study's "recommended" alternative concept. Each member of the Technical Subcommittee voiced their preferences for one of the five proposed concepts or a modification of one of these concepts. The engineering consultant to the MDC also indicated two preferences for the "recommended" concept. One preference was for advanced waste treatment facilities in Canton on the Neponset River, in Dedham on the Charles River and in Framingham on the Sudbury River. The other preference was for an advanced waste treatment facility in Canton, and a basin diversion of the Framingham facility flow to an advanced

RATING FORM

	Weight	Concepts				
		1	2	3	4	5
Engineering Factors						
1. Total Capital Costs	3.6	1	2	4	3	5
2. Annual O & M Costs	2.7	2	4	1	5	3
2a. Demand for chemicals 2b. Demand for energy 2c. Manpower requirements						
3. Conformance with Existing Sewage Plans	4.4	1	2	4	3	5
4. Ability to Handle Unanticipated Flows	3.6	3	2	5	1	4
5. Suitability to Phase Construction	5.1	3	2	5	1	4
6. Plant Reliability	2.8	2	3	1	4	5
7. Generation of Sludge Ash	5.1	1	4	1	4	1
8. Potential for Direct Water Reuse	3.8	3	2	5	1	4
9. Availability & Suitability of Land	4.1	1	3	1	3	5
Water Quality Factors						
10. Impact on In-Stream Water Quality						
10a. Effect of effluents on water quality standards	2.0	2	3	1	4	5
10b. Capacity of receiving waters to handle effluents	1.6	2	3	1	4	5
11. Effect on River Flows						
11a. Ability to retain flows in basin or origin	2.9	3	2	5	1	3
11b. Opportunities for flow augmentation and flow stabilization	3.2	4	2	5	1	3

Figure 7

	Weight	Concepts				
		1	2	3	4	5
12. Impact on Groundwater Recharge	3.6	4	3	5	2	1
13. Impact on Fish & Wildlife	3.0	4	2	5	1	3
14. Compatibility with State, Regional and Local Land Use and Development Plans	3.4	2	3	1	4	5
15. Effect on Employment and Income	4.9	1	4	2	5	3
16. Impact on Agriculture, Forestry and Commercial Fishing	5.5	3	3	3	2	1
17. Opportunities for Recreation and Tourism	4.4					
18. Potential for Local Autonomy	5.6	3	3	4	1	5
19. Costs to Local Communities	4.3	1	4	2	5	3
Public Health Factors						
20. Protection of Water Supplies	1.8	1	2	4	3	5
21. Effect on Noise Levels	5.3	1	1	1	1	1
22. Impact on Air Quality	3.8	1	1	1	1	1
Design Factors						
23. Visual, Cultural and Design Impacts	4.8	3	1	4	1	4
Weighed Totals						
Engineering Factors (1-9)		64	91	108	91	134
Environmental Factors (10-23)		129	131	154	126	154
TOTAL		193	222	262	217	288
Rank		1	3	4	2	5

Figure 7 (cont)

treatment facility in the Middle Charles area. Both preferences included three advanced waste treatment facilities on the upper Charles in Medway, Milford, and Medfield.

A vote was then taken for the recommended concept on a facility basis. Satellite advanced waste treatment facilities on the upper Charles and in Canton, Woburn, Dedham, Framingham and on the Middle Charles received the most votes. It was then agreed that the recommended alternative would include three advanced facilities on the upper Charles, an advanced facility in Canton, a small (2 mgd) advanced facility on the Aberjona River in Woburn for flow augmentation purposes, and either advanced facilities in Framingham and Dedham, or a facility on the Middle Charles. It was also decided that proposed facilities serving peripheral towns (See Concepts 1-5) would receive no further emphasis since these towns would not be included in the study's Proposed Metropolitan Sewerage District Area. It was voted that the subcommittee meet again to determine the final configuration of the recommended alternative.

Impact analyses were performed by the various consultants on the proposed Middle Charles facility, (See Section G(2)). Two reports that had a large impact on the decision concerning the Middle Charles treatment facility were an open-file report by the U.S. Geological Survey entitled "Groundwater Management, Charles River Basin, Massachusetts" and a report by the U.S. Army Corps of Engineers entitled "The Potential Effects of Wastewater Treatment Alternatives on the Flow of the Concord River below River Meadow Brook at Lowell." The report on the Charles River Basin predicted that if the towns of Dedham, Needham, Wellesley and part of Natick meet their projected 1990 water demands with water derived from the basin, and if, after use, all their water is sewered out of the basin, the flow of the Charles River at Waltham can be expected to approach zero for approximately 9 days during an average year. Also, if the maximum monthly demand is expected to be 1.2 times greater than the average demand and is expected to occur when streamflow is lowest, the flow of the river will be expected to approach zero for approximately 14 days during an average year.

The report on the Concord River predicted that, assuming present water supply and wastewater management trends, in the year 2000, the flow of the Concord River will, on the average be slightly higher than at present. The report on the Concord River is presented in Appendix E.

In January 1975, the Technical Subcommittee met and considering the consultant's impact analyses voted that the Middle Charles facility be part of the recommended alternative (Figure 8). Maintenance of adequate flow in the Charles River was considered to be a more important issue than avoidance of adverse impacts that could potentially be caused by treatment facility discharge to the Charles (See Section G(2).,

The Recommended Plan

Figure 8

analysis is of Recommended Plan). A summary of the study's status (See Appendix F) was sent to all citizens on the mailing list and pre - public meetings for town officials in each watershed were held to present and explain the recommended system. Most comments on the recommendations were favorable.

Four public meetings were held at the end of January 1975 in watersheds receiving significant impact from the recommended alternative. Comments at each meeting directed toward effects of the alternative on the specific watershed.

In Woburn (Mystic River Watershed) citizens were concerned about the effects of added flow under flood conditions and the effect of effluent on water quality. The rationale for a 2 mgd facility was questioned, and there were suggestions for flow augmentation by other means. Citizens were also concerned about the division of costs; many felt that towns downstream of the facility should pay, as they would also benefit from improvement in water quality.

In Canton (Neponset River Watershed) citizens were most concerned about the location of the plant. It was felt that Canton could not afford to give up more land. There was also concern over the effects of the effluent on the marshland, fish, and water supply wells in Fowl Meadow Marsh.

In Quincy (Boston Harbor), objections were raised to expansion of the Nut Island facility. Citizens commented on the adverse effects of effluent from the currently overloaded Nut Island facility to Quincy Bay. Some supported the idea of upstream treatment plants to reduce the load at Nut Island, while others favored transferring part of the load to Deer Island, or construction of deep ocean outfalls. The need for secondary treatment was also questioned.

In Needham (Charles River Watershed), foremost concern was for the location of the Middle Charles facility, and for the effects of the facilities effluent on water supply wells, aquatic life and recreation areas. There was also much discussion over recycling and reuse of wastewater and sludges.

Public meetings were held in May and June 1975 to present institutional - financial alternatives and plans for management of combined sewer overflows. Again there was a large amount of public concern over impacts of treatment facilities on local watersheds, emphasizing a need for the Technical Subcommittee to make efforts to resolve the public's anxieties before final adoption of the Recommended Plan.

2. Summary of Impacts

Impact analysis is the measurement of change resulting from the implementation of a certain "plan action" or component of an alternative engineering system. This change is measured against a baseline condition, which in most cases, is the "without" condition.

In the BH-EMMA Study, six impact disciplines were identified:

1. Aesthetic
2. Biological
3. Engineering
4. Hygienic
5. Institutional-Financial
6. Socio-Economic

The Corps of Engineers contracted four individual consultants to perform biological, hygienic, socio-economic, and aesthetic impact analysis. Engineering and financing and management impact assessment was carried out by consultants to the MDC (See Technical Data Volumes 4, 5, and 12).

It would have been more efficient in terms of co-ordination and integration of the impact analysis task to either perform impact analysis in house or contract one consulting firm to perform impact analysis in all four disciplines. However, expertise in these varied disciplines was not available at the Corps of Engineers for the BH-EMMA Study and it was felt that performance of all impact analyses by one consulting firm would jeopardize the objectivity of the study findings. As most consulting firms specialize in one particular discipline, contracting a particular consulting firm to perform impact analyses in several disciplines may lead to a bias in the firms field of specialization.

To promote co-ordination within the impact analysis team, frequent meetings were held for the consultants by the Corps of Engineers to report on the progress of the Study and to allow interchange of ideas and findings. Meetings were also held between various consultants and both State and Federal government resource people.

Each impact discipline was divided into several impact categories or topics in which effects could be measured. Categories in each discipline are listed below:

Aesthetic - (Visual cultural and design)
regional land use plans
local land use plans
adjacent development
adjacent landscape
environment (water and air quality, noise odor, etc.)

Biological - In-stream water quality
groundwater
aquatic environment
terrestrial environment

Hygienic - water supplies
recreation areas
shellfish harvesting areas

Socio-Economic - land use
population and housing
industrial activity
recreation
commercial activity
agricultural and forestry
municipal finance
employment and income

First, each consultant established a baseline condition for each category within a particular impact discipline. Then, the effects of each alternative concept on the impact categories were analyzed in terms of both magnitude and duration (short or long-term). Results of the individual impact analyses are found in Technical Data Volumes 13A through 13D.

It was difficult to establish a means to summarize impacts in all four disciplines as:

a. The definition of "baseline" condition differed for each discipline. For some disciplines, such as Biological, baseline meant present day conditions, while for disciplines such as Aesthetic, baseline conditions largely meant projected conditions resulting from the implementation of state and local plans for future land use in study area.

b. The methodology for impact identification and analysis differed among the disciplines. For example, hygienic impacts of the concepts were compared and rated by river basin. Socio-economic impacts of the 6 concepts were compared and rated by impact categories such as population, land use, etc., through the entire study area.

c. Some consultants performed impact analysis only in areas where there would be a differential in impacts among the concepts, while other consultants performed impact analysis in all areas even when proposed plans for certain areas did not differ among the concepts.

d. Measurement of change or effects resulting from implementation of a proposed concept differed among disciplines. If the baseline meant present day conditions, positive effects were interpreted as an improvement over current conditions, and negative effects were interpreted as decline from current conditions. If the baseline meant a

projected condition (such as the MAPC Plan for Open Space and Recreation) positive effects were construed as compatibility, and negative effects were construed as non-compatibility, with the projected condition. (This assumes the projected condition is a positive condition).

e. Different rating systems were used by the various consultants. For example, aesthetic impact consultants evaluated treatment facility sites quantitatively by totaling, separately, the numbers of positive and negative impacts. A concept was rated according to totals of positive and negative impacts obtained in evaluation of all facilities designated in the concept. However, Biological impact consultants rated each facility site qualitatively as "highly acceptable", "acceptable", and "not acceptable".

Despite discrepancies between the various consultants methodologies for impact analysis, an attempt is made on the following pages to summarize all impacts in a consistent manner. There are four Impact Summary forms for each concept. Each of these four Impact Summary forms displays impacts in a different discipline (Aesthetic, Biological, Hygienic or Socio-economic). Impacts are listed vertically, first beneficial impacts, then adverse. River basins or land areas affected or impacted upon are listed horizontally across the top of the form (see sample Impact Summary Form, Figure 9). If a specific beneficial impact pertains to a particular river basin, the box related to the river basin and impact is shaded. If the impact is related only to certain proposed facilities in the basin, the facility sites are listed in the shaded box. Impacts of a short term nature are designated by the letter (S). The same procedure is followed for adverse impacts, except boxes are cross-hatched rather than shaded. Measures recommended by consultants to mitigate adverse effects resulting from each alternative concept are listed on the right-hand side of the chart, opposite the adverse effect they address. Finally, it must be remembered that judgment of impacts as adverse or beneficial is a subjective matter. The impact "stimulates growth and development" may be beneficial to some communities and adverse to others. This is especially true in the judgment of impacts which are "compatible" or "incompatible" with proposed land-use plans, where the classification of an impact as beneficial assumes that the proposed land-use plan will have a positive impact on the study area.

To summarize the conclusions of the individual impact consultants analyses:

a. On a regional basis, the Aesthetic impact analysis indicated a preference for decentralized alternatives (Concept 2 and 4). However, a site specific impact analysis showed Concept 3 (maximum expansion of the Metropolitan Sewerage District) to have a lower percentage of sites not recommended for construction. Of the two concepts proposing decentralization of the Metropolitan Sewerage District, Concept 2 had a lower percentage of sites not recommended for construction. Thus, from an overall visual-cultural and design point of view, Concept 2 was indicated to be the preferred Concept. Concept 5 did not exhibit sufficient justification for implementation.

FIGURE 9
IMPACT SUMMARY FORM

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH R.	SOUTH COASTAL-NORTH R.	SUASCO	
A. BENEFICIAL								
B. ADVERSE								MITIGATION MEASURES

Comparison of the Recommended Plan to Concept 2 showed the Recommended Plan to have fewer negative impacts leading to a preference for the Recommended Plan over Concept 2.

b. The Biological impact analysis favored the more centralized Concepts 1 and 3 over the decentralized Concepts 2 and 4 due to the degree of uncertainty with regard to quality control of large wastewater treatment facilities. Concept 1 was preferred over Concept 3 due to positive impacts of the Upper Charles treatment facilities and lowered effluent discharge to Boston Harbor from the Nut Island facility. With regard to water quality impacts, the Recommended Plan was rated as intermediate between the more acceptable Concepts 1 and 3 and the lesser acceptable Concepts 2 and 4. Concept 5 was not recommended, as a shift of wastewater load from Boston Harbor to terrestrial sites in Southeastern Massachusetts would not appreciably improve environmental conditions in Boston Harbor. It was also felt that uncertainties exist concerning the capacity of New England soils to adequately rennovate secondary effluent.

Another important finding of the Biological impact analysis was that stormwater runoff and combined sewer overflows were the major sources of pollution to Boston Harbor; upgrading the Harbor treatment facilities to secondary treatment would do little to improve water quality in Boston Harbor.

c. The Hygienic impact analysis showed preference for Concept 1 as this Concept did not create the negative impacts of 1) lowered flow on the Charles River (found in Concept 3) and 2) potential increased nitrate and virus concentrations on in streams receiving effluent discharge (found in Concepts 2 and 4). The Recommended Plan was rated intermediate between centralized and decentralized Concepts. Concept 5 was not recommended due to possible health hazards created by a breakdown of long transmission lines or a decline in the soils treatment efficiency.

The Hygienic impact analysis also found improvement of water quality in Boston Harbor to be largely dependant on correction of combined sewer overflow and stormwater runoff problems.

d. The Socio-economic impact analysis initially found Concept 1 to create the least number of negative impacts. Analysis of the Recommended Plan was quite favorable, as it responds to public preference by achieving limited decentralization at approximately the same capital costs, but at significantly lower O & M costs, than initial decentralized Concepts, and provides a remedy to perennial low flow conditions on the Charles River.

The Study did not specify a plan maximizing National Economic Development, and a plan maximizing Environmental Quality. Impact analyses did find Concept 1 to create a fewer number of adverse environmental impacts than other concepts. Concept 1 was also lowest in cost. However, Concept 1 cannot be labeled a National Economic Development Plan as the value of resources required to implement this Concept were not included in the computation of costs.

CONCEPT 1
AESTHETIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH RIVER	SOUTH COASTAL-NORTH RIVER	SUASCO	
A. BENEFICIAL								
IMPROVES WATER QUALITY AND RECREATIONAL OPPORTUNITY								
IS CONSISTENT WITH REGIONAL DEVELOPMENT PROPOSALS								
IS COMPATIBLE WITH SURROUNDING DEVELOPMENT								
IS CONSISTENT WITH GENERAL DEVELOPMENT PLANS								
PRESERVES AND ENHANCES OPEN SPACE								
VISUALLY ENHANCES LANDSCAPE								
CREATES NEW RECREATION AREAS								
ENCOURAGES ACCESS TO EXISTING RECREATION AREAS AND OPEN SPACE								
SATISFIES NEED OF OLDER RESIDENTIAL COMMUNITY								
B. ADVERSE								MITIGATION MEASURES
IS VISUALLY INCOMPATIBLE WITH SURROUNDING DEVELOPMENT AND LAND FORM				MEDWAY	ESSEX GLOUCESTER (3) GLOUCESTER 1 GLOUCESTER (4) MANCHESTER MANSFIELD MIDDLETON ROCKPORT SWAMPSCOTT	COHASSET MARSHFIELD	BILLERICA CONCORD SUDBURY	MINIMIZE BY CAREFUL DESIGN AND SITING
IS INCONSISTENT WITH REGIONAL DEVELOPMENT PROPOSALS				MEDWAY	HAMILTON	COHASSET	CONCORD	
IS INCOMPATIBLE WITH GENERAL DEVELOPMENT PLANS				MEDFIELD	SWAMPSCOTT			
CAUSES LOSS OF RECREATION AREAS AND OPEN SPACE	QUINCY							
RESTRICTS ACCESS TO RECREATION AREAS AND OPEN SPACE				MEDWAY	GLOUCESTER (4)		BILLERICA HOPKINTON	
MAY CAUSE LOSS OF HOUSING	QUINCY							
DISRUPTS SURROUNDING ECOLOGY								
DESTROYS HISTORICAL, CULTURAL AND SCENIC LANDMARKS	QUINCY					HULL		
INTRUDES ON MARSHLAND					ESSEX GLOUCESTER (3)	COHASSET MARSHFIELD ROCKLAND SCITUATE	SUDBURY	
LOWERS SURFACE WATER LEVELS AND REDUCES PERCOLATION AND GROUNDWATER RECHARGE				MEDFIELD	HAMILTON ROCKPORT	COHASSET SCITUATE ROCKLAND	BILLERICA CONCORD	
CAUSES ODORS AND NOISE					GLOUCESTER 1 SWAMPSCOTT	MARSHFIELD		
CANNOT ACCOMMODATE EXPANSION				MEDWAY				
CAUSES DISRUPTION DURING CONSTRUCTION (5)					GLOUCESTER 1 ROCKPORT	COHASSET HULL	CONCORD	

CONCEPT 2
AESTHETIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH RIVER	SOUTH COASTAL-NORTH RIVER	SUASCO	
A. BENEFICIAL								
IMPROVES WATER QUALITY AND RECREATIONAL OPPORTUNITY								
IS CONSISTENT WITH REGIONAL DEVELOPMENT PROPOSALS								
IS COMPATIBLE WITH SURROUNDING DEVELOPMENT								
IS CONSISTENT WITH GENERAL DEVELOPMENT PLANS								
PRESERVES AND ENHANCES OPEN SPACE								
VISUALLY ENHANCES LANDSCAPE								
CREATES NEW RECREATION AREAS								
ENCOURAGES ACCESS TO EXISTING RECREATION AREAS AND OPEN SPACE								
SATISFIES NEED OF OLDER RESIDENTIAL COMMUNITY								
B. ADVERSE								MITIGATION MEASURES
IS VISUALLY INCOMPATIBLE WITH SURROUNDING DEVELOPMENT AND LAND FORM				MEDWAY, WRENTHAM	ESSEX, GLOUCESTER (2), HAMILTON, GLOUCESTER (3), GLOUCESTER (1), MANCHESTER, HAMILTON, MIDDLETON, ROCKPORT, SWAMPSCOTT	COHASSET, MARSHFIELD	BILLERICA, CONCORD, SUDBURY	MINIMIZE BY CAREFUL DESIGN AND SITING
IS INCONSISTENT WITH REGIONAL DEVELOPMENT PROPOSALS				MEDWAY	HAMILTON	COHASSET	CONCORD	
IS INCOMPATIBLE WITH GENERAL DEVELOPMENT PLANS				MEDFIELD	SWAMPSCOTT			
CAUSES LOSS OF RECREATION AREA AND OPEN SPACE	DEER I.							
RESTRICTS ACCESS TO RECREATION AREAS AND OPEN SPACE				MEDWAY	GLOUCESTER I.		BILLERICA, SUDBURY	
MAY CAUSE LOSS OF HOUSING	BOSTON							
DISRUPTS SURROUNDING ECOLOGY								
DESTROYS HISTORICAL, CULTURAL AND SCENIC LANDMARKS	BOSTON					HULL		
INTRUDES ON MARSHLAND					ESSEX, GLOUCESTER (3)	COHASSET, MARSHFIELD, ROCKLAND, SCITUATE	SUDBURY	
LOWERS SURFACE WATER LEVELS AND REDUCES PERCOLATION AND GROUNDWATER RECHARGE				MEDFIELD	HAMILTON, ROCKPORT	COHASSET, SCITUATE, ROCKLAND	BILLERICA, CONCORD	
CAUSES ODORS AND NOISE					GLOUCESTER (3), SWAMPSCOTT	MARSHFIELD		
CANNOT ACCOMMODATE EXPANSION				MEDWAY, MEDFIELD			FRAMINGHAM	
CAUSES DISRUPTION DURING CONSTRUCTION (S)					GLOUCESTER I., ROCKPORT	COHASSET, HULL	CONCORD	

CONCEPT 3
AESTHETIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL - IPSWICH RIVER	SOUTH COASTAL - NORTH RIVER	SUASCO	
A. BENEFICIAL								
IMPROVES WATER QUALITY AND RECREATIONAL OPPORTUNITY								
IS CONSISTENT WITH REGIONAL DEVELOPMENT PROPOSALS								
IS COMPATIBLE WITH SURROUNDING DEVELOPMENT								
IS CONSISTENT WITH GENERAL DEVELOPMENT PLANS								
PRESERVES AND ENHANCES OPEN SPACE								
VISUALLY ENHANCES LANDSCAPE								
CREATES NEW RECREATION AREAS								
ENCOURAGES ACCESS TO EXISTING RECREATION AREAS AND OPEN SPACE								
SATISFIES NEED OF OLDER RESIDENTIAL COMMUNITY								
B. ADVERSE								MITIGATION MEASURES
IS VISUALLY INCOMPATIBLE WITH SURROUNDING DEVELOPMENT AND LANDFORM					ESSEX GLOUCESTER M. GLOUCESTER MA GLOUCESTER A MANCHESTER HAMILTON MIDDLETON ROCKPORT SWAMPSCOTT	CONCORD MARSHFIELD	BILLERICA CONCORD READING	MINIMIZE BY CAREFUL DESIGN AND SITING
IS INCONSISTENT WITH REGIONAL DEVELOPMENT PROPOSALS					HAMILTON	CONCORD	CONCORD	
IS INCOMPATIBLE WITH GENERAL DEVELOPMENT PLANS					SWAMPSCOTT			
CAUSES LOSS OF RECREATION AREAS AND OPEN SPACE	BOSTON							
RESTRICTS ACCESS TO RECREATION AND OPEN SPACE					GLOUCESTER A		BILLERICA READING	
MAY CAUSE OF HOUSING	BOSTON							
DISRUPTS SURROUNDING ECOLOGY								
DESTROYS HISTORICAL, CULTURAL AND SCENIC LANDMARKS	BOSTON					CONCORD		
INTRUDES ON MARSHALND					ESSEX GLOUCESTER M.	CONCORD MARSHFIELD ROCKLAND SCITUATE	CONCORD	
LOWERS SURFACE WATER LEVELS AND REDUCES PERCOLATION AND GROUNDWATER RECHARGE					HAMILTON ROCKPORT	CONCORD SCITUATE ROCKLAND	BILLERICA CONCORD	
CAUSES ODORS AND NOISE					GLOUCESTER A. SWAMPSCOTT	MARSHFIELD		
CANNOT ACCOMMODATE EXPANSION								
CAUSES DISRUPTION DURING CONSTRUCTION (S)					GLOUCESTER A ROCKPORT	CONCORD DALE	CONCORD	

CONCEPT 4
AESTHETIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL - IPSWICH RIVER	SOUTH COASTAL - NORTH RIVER	SUASCO	
A. BENEFICIAL								
IMPROVES WATER QUALITY AND RECREATIONAL OPPORTUNITY								
IS CONSISTENT WITH REGIONAL DEVELOPMENT PROPOSALS					GLOUCESTER(M)	HULL	BILLERICA HUDSON MARLBOROUGH W.	
IS COMPATIBLE WITH SURROUNDING DEVELOPMENT					MIDDLETON TOPSFIELD SALEM		HUDSON	
IS CONSISTENT WITH GENERAL DEVELOPMENT							BILLERICA	
PRESERVES AND ENHANCES OPEN SPACE								
VISUALLY ENHANCES LANDSCAPE					SALEM	HULL	HUDSON	
CREATES NEW RECREATION AREA					SALEM	ROCKLAND	FRAMINGHAM	
ENCOURAGES ACCESS TO EXISTING RECREATION AREAS AND OPEN SPACE					MIDDLETON MANCHESTER SALEM			
SATISFIES NEED OF OLDER RESIDENTIAL COMMUNITY					GLOUCESTER(M) GLOUCESTER L. MIDDLETON ROCKPORT	HULL		
B. ADVERSE								MITIGATION MEASURES
IS VISUALLY INCOMPATIBLE WITH SURROUNDING DEVELOPMENT AND LANDFORM		WOBURN		MEDWAY WATERTOWN	ESSEX GLOUCESTER(M) GLOUCESTER(C) GLOUCESTER L. MANCHESTER HAMILTON MIDDLETON ROCKPORT SWAMPSCOTT	COHASSET MARSHFIELD	BILLERICA CONCORD SUDBURY	MINIMIZE BY CAREFUL DESIGN AND SITING
IS INCONSISTENT WITH REGIONAL DEVELOPMENT PROPOSALS				MEDWAY	HAMILTON	COHASSET	CONCORD	
IS INCOMPATIBLE WITH GENERAL DEVELOPMENT PLANS				MEDFIELD	SWAMPSCOTT			
CAUSES LOSS OF RECREATION AREA AND OPEN SPACE	DEER I.	MEDFORD						
RESTRICTS ACCESS TO RECREATION AREAS AND OPEN SPACE				MEDWAY	GLOUCESTER L.		BILLERICA HUDSON	
MAY CAUSE LOSS OF HOUSING	DEER I.							
DISRUPTS SURROUNDING ECOLOGY								
DESTROYS HISTORICAL, CULTURAL AND SCENIC LANDMARKS	DEER I.	MEDFORD				HULL		
INTRUDES ON MARSHLAND		WOBURN			ESSEX GLOUCESTER(M)	COHASSET MARSHFIELD ROCKLAND SCITUATE	SUDBURY	
LOWERS SURFACE WATER LEVELS AND REDUCES PERCOLATION AND GROUNDWATER RECHARGE				MEDFIELD	HAMILTON ROCKPORT	COHASSET SCITUATE ROCKLAND	BILLERICA CONCORD	
CAUSES ODORS AND NOISE					GLOUCESTER L. SWAMPSCOTT	MARSHFIELD		
CANNOT ACCOMMODATE EXPANSION				MEDWAY DEDHAM			FRAMINGHAM	
CAUSES DISRUPTION DURING CONSTRUCTION (S)		WOBURN			GLOUCESTER L. ROCKPORT	COHASSET HULL	CONCORD	

CONCEPT 5
AESTHETIC IMPACTS *

IMPACT	LAKEVILLE FREETOWN	FALL RIVER FREETOWN	PLYMOUTH CARVER	BOURNE E.	BOURNE W.	
A. BENEFICIAL						
INCREASES PUBLICLY CONTROLLED LAND	■	■	■			
IS COMPATIBLE WITH PLANS FOR EXPANSION OF PUBLIC OPEN SPACE	■	■				
PROVIDES WATER TO DRY AREA, INCREASING VEGETATIVE GROWTH AND VARIETY	■	■	■	■	■	
INCREASES GROUNDWATER LEVELS	■	■	■	■	■	
B. ADVERSE						MITIGATION MEAS.
REDUCES RECREATIONAL USEFULNESS OF A FORESTED AREA		▨	▨			
IS VISUALLY INAPPROPRIATE DUE TO LARGE STORAGE LAGOONS	▨	▨	▨	▨		MINIMIZE THROUGH SENSITIVE DESIGN
WITHDRAWS LAND FROM HOUSING MARKET		▨	▨	▨	▨	
HAS NEGATIVE IMPACT ON CRANBERRY BOGS		▨				
REMOVES MUCH USED WOODLAND	▨					
REQUIRES REMOVAL OR RELOCATION OF MINOR STREAMS	▨					
MAY DEGRADE LOCAL SURFACE OF GROUNDWATER SUPPLIES IN EVENT OF SYSTEM MALFUNCTION	▨		▨	▨	▨	PROPER DESIGN AND SUFFICIENT MONITORING
MAY DAMAGE LARGE AREAS OF VEGETATION IN EVENT OF SYSTEM MALFUNCTION			▨	▨	▨	PROPER DESIGN AND SUFFICIENT MONITORING
LACKS LOCAL BENEFITS	▨	▨	▨	▨	▨	
PROHIBITS HIGHWAY EXPANSION					▨	

* IMPACTS OF TREATMENT FACILITIES AND INTERCEPTORS ARE SAME AS CONCEPT 4.

"RECOMMENDED PLAN" AESTHETIC IMPACTS								
IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH RIVER	SOUTH COASTAL-NORTH RIVER	SUASCO	
A. BENEFICIAL								
IMPROVES WATER QUALITY AND RECREATIONAL OPPORTUNITY								
IS CONSISTENT WITH REGIONAL DEVELOPMENT PROPOSALS								
IS COMPATIBLE WITH SURROUNDING DEVELOPMENT								
IS CONSISTENT WITH GENERAL DEVELOPMENT PLANS								
PRESERVES AND ENHANCES OPEN SPACE								
VISUALLY ENHANCES LANDSCAPE								
CREATES NEW RECREATION AREA								
ENCOURAGES ACCESS TO RECREATION AREAS AND OPEN SPACE								
SATISFIES NEED OF OLDER RESIDENTIAL COMMUNITY								
B. ADVERSE								MITIGATION MEASURES
IS VISUALLY INCOMPATIBLE WITH SURROUNDING DEVELOPMENT AND LANDFORM								MINIMIZE BY CAREFUL DESIGN AND SITING
IS INCONSISTENT WITH REGIONAL DEVELOPMENT PROPOSALS								
IS INCOMPATIBLE WITH GENERAL DEVELOPMENT PLANS								
CAUSES LOSS OF RECREATION AREAS AND OPEN SPACE								
RESTRICTS ACCESS TO RECREATION AREAS AND OPEN SPACE								
MAY CAUSE LOSS OF HOUSING								
DISRUPTS SURROUNDING ECOLOGY								
DESTROYS HISTORICAL, CULTURAL AND SCENIC LANDMARKS								
INTRUDES ON MARSHLAND								
LOWERS SURFACE WATER LEVELS AND REDUCES NATURAL PERCOLATION								
CAUSES ODORS AND NOISE								
CANNOT ACCOMMODATE EXPANSION								
CAUSES DISRUPTION DURING CONSTRUCTION (S)								

CONCEPT 1
BIOLOGICAL IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH R.	SOUTH COASTAL-NORTH RIVER	SUASCO	
A. BENEIFICAL								
IMPROVES WATER QUALITY DUE TO IMPROVED TREATMENT	■							
IMPROVES WATER QUALITY DUE TO SMALLER EFFLUENT DISCHARGE								
IMPROVES WATER QUALITY THRU ALLEVIATION OF NON-POINT SOURCE POL.					■		■	
AUGMENTS RIVER FLOW CREATING A MORE STABLE AQUATIC ENVIRONMENT (S)							■	
STABILIZES DISSOLVED OXYGEN LEVELS IN RIVER INCREASING GAME FISH POPULATION				■				
REDUCES STIMULUS TO EUTROPHICATION				■				
B. ADVERSE								MITIGATION MEASURES
STIMULATES EUTROPHICATION AND OXYGEN DEFICITS LEADING TO DEATH OF FINFISH							▨ SUBURBAN	Employ denitrification to remove nitrates from effluent
REDUCES FLOW CAUSING LOWER WATER QUALITY AND REDUCTION OF SUITABLE HABITAT FOR AQUATIC LIFE								
REDUCES LITTORAL (SHORE) ZONES LEADING TO UNDESIRABLE VASCULAR PLANTS								
MAY PRODUCE CHLORAMINE CONCENTRATIONS TOXIC TO AQUATIC LIFE					▨		▨	Employ ozonation as a disinfection proc.

CONCEPT 2
BIOLOGICAL IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH R.	SOUTH COASTAL-NORTH RIVER	SUASCO	
A. BENEFICIAL								
IMPROVES WATER QUALITY DUE TO IMPROVED TREATMENT	■							
IMPROVES WATER QUALITY DUE TO SMALLER EFFLUENT DISCHARGE	■							
IMPROVES WATER QUALITY THROUGH ALLEVIATION NON-POINT SOURCE POLLUT.					■		■	
AUGMENTS RIVER FLOW, CREATING A MORE STABLE AQUATIC ENVIRONMENT (S)			■				■	
STABILIZES DISSOLVED OXYGEN LEVELS IN RIVER INCREASING GAME FISH POPULATION				■				
REDUCES STIMULUS TO EUTROPHICATION				■				
B. ADVERSE								MITIGATION MEASURES
STIMULATES EUTROPHICATION AND OXYGEN DEFICITS LEADING TO DEATH OF FINFISH			▨	DEDHAM WATERTOWN			SUDBURY FRAMINGHAM	Employ denitrification to remove nitrates from effluent
REDUCES FLOW CAUSING LOWER WATER QUALITY AND REDUCTION OF SUITABLE HABITAT FOR AQUATIC LIFE								
REDUCES LITTORAL (SHORE) ZONES LEADING TO UNDESIRABLE VASCULAR PLANTS			▨					
MAY PRODUCE CHLORAMINE CONCENTRATIONS TOXIC TO AQUATIC LIFE			▨	DEDHAM WATERTOWN	▨		▨	Employ ozonation as a disinfection process

CONCEPT 3
BIOLOGICAL IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH R.	SOUTH COASTAL-NORTH RIVER	SUASCO	
A. BENEFICIAL								
IMPROVES WATER QUALITY DUE TO IMPROVED TREATMENT	■							
IMPROVES WATER QUALITY DUE TO SMALLER EFFLUENT DISCHARGE	■							
IMPROVES WATER QUALITY THRU ALLEVIATION OF NON-POINT SOURCE POLLUT.					■		■	
AUGMENTS RIVER FLOW CREATING A MORE STABLE AQUATIC ENVIRONMENT (S)							■	
STABILIZES DISSOLVED OXYGEN LEVELS IN RIVER INCREASING GAME FISH POPULATION								
REDUCES STIMULUS TO EUTROPHICATION								
B. ADVERSE								MITIGATION MEASURES
STIMULATES EUTROPHICATION AND OXYGEN DEFICITS LEADING TO DEATH OF FINFISH							▨	Employ denitrification to remove nitrates
REDUCES FLOW CAUSING LOWER WATER QUALITY AND REDUCTION OF SUITABLE HABITAT FOR AQUATIC LIFE				▨				
REDUCES LITTORAL (SHORE) ZONES LEADING TO UNDESIRABLE VASCULAR PLANTS								
MAP PRODUCE CHLORAMINE CONCENTRATIONS TOXIC TO AQUATIC LIFE							▨	Employ ozonation as a disinfection process

CONCEPT 4
BIOLOGICAL IMPACTS

IMPACTS	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH R.	SOUTH COASTAL-NORTH RIVER	SUASCO	
A. BENEFICIAL								
IMPROVES WATER QUALITY DUE TO IMPROVED TREATMENT	■							
IMPROVES WATER QUALITY DUE TO SMALLER EFFLUENT DISCHARGE	■							
IMPROVES WATER QUALITY THRU ALLEVIATIONS OF NON-POINT SOURCE POLLUT					■		■	
AUGMENTS RIVER FLOW CREATING A MORE STABLE AQUATIC ENVIRONMENT(S)		■	■				■	
STABILIZES DISSOLVED OXYGEN LEVELS IN RIVER INCREASING GAME FISH POPULATION				■				
REDUCES STIMULUS TO EUTROPHICATION				■				
B. ADVERSE								MITIGATION MEASURES
STIMULATES EUTROPHICATION AND OXYGEN DEFICITS LEADING TO DEATH OF FINFISH		▨	▨	DEDHAM WATER TOWN			SUDBURY FRAMINGHAM	Employ denitrification to remove nitrate from effluent
REDUCES FLOW CAUSING LOWER WATER QUALITY AND REDUCTION OF SUITABLE HABITAT FOR AQUATIC LIFE								
REDUCES LITTORAL (SHORE) ZONES LEADING TO UNDESIRABLE VASCULAR PLANTS			▨					
MAY PRODUCE CHLORAMINE CONCENTRATIONS TOXIC TO AQUATIC LIFE		▨	▨	DEDHAM WATERTOWN	▨		▨	Employ ozonation as a disinfection process

CONCEPT 5
BIOLOGICAL IMPACTS

IMPACTS	LAKEVILLE FREETOWN	FALL RIVER FREETOWN	PLYMOUTH CARVER	BOURNE E.	BOURNE W.	
A. BENEFICIAL						
MAY PROVIDE BETTER REMOVAL OF WASTEWATER CONSTITUENTS THAT WOULD HAVE A NEGATIVE IMPACT ON AQUATIC ECOSYSTEMS						
INCREASES PRIMARY PRODUCTIVITY OF AGRICULTURAL OF FOREST AND ECOSYSTEMS.						
POSSIBLE INCREASE IN GAME SPECIES ON APPLICATION SITES						
INCREASES NUTRITIONAL CONTENT OF PLANTS						
B. ADVERSE						MITIGATION MEASURES
BREAKDOWN IN SOILS TREATMENT EFFICIENCY MAY CAUSE CONTAMINATION OF GROUNDWATER						CAREFUL MONITORING AND MAINTENANCE OF SITES
APPLICATION DURING PERIODS OF FREEZING TEMPERATURES OR VERY WARM TEMPERATURES MAY CAUSE CONTAMINATION OF GROUNDWATER DUE TO REDUCTION OF SOILS INFILTRATION CAPACITY, PONDING AND/OR RUNOFF AND SOIL EROSION. (S)						CAREFUL MONITORING AND MAINTENANCE OF SITES
AEROSOLS GENERATED BY SPRAY IRRIGATION MAY CONTAMINATE AIR WITH PATHOGENIC ORGANISMS						
CHEMICAL CONSTITUENTS IN WASTEWATER MAY BE TOXIC TO PLANTS						
EXCESSIVE SOIL MOISTURE MAY ADVERSELY ALTER WOOD PROPERTIES OF TREES						
MAY CAUSE WATERLOGGING AND DEATH TO PLANTS						

"RECOMMENDED PLAN" BIOLOGICAL IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH R.	SOUTH COASTAL-NORTH RIVER	SUASCO	
A. BENEFICIAL								
IMPROVES WATER QUALITY DUE TO IMPROVED TREATMENT	■							
IMPROVES WATER QUALITY DUE TO SMALLER EFFLUENT DISCHARGE	■							
IMPROVES WATER QUALITY THRU ALLEVIATION OF NON-POINT SOURCE POL.								
AUGMENTS RIVER FLOW CREATING A(S) MORE STABLE AQUATIC ENVIRONMENT		■	■	■				
STABILIZES DISSOLVED OXYGEN LEVELS IN RIVER INCREASING GAME FISH POPULATION				■				
REDUCES STIMULUS TO EUTROPHICATION				■				
B. ADVERSE								MITIGATION MEASURES
STIMULATES EUTROPHICATION AND OXYGEN DEFICITS LEADING TO DEATH OF FINFISH		▨	▨	MIDDLE CHARLES				Employ denitrification to remove nitrate from effluent
REDUCES FLOW CAUSING LOWER WATER QUALITY AND REDUCTION OF SUITABLE HABITAT FOR AQUATIC LIFE								
REDUCES LITTORAL (SHORE) ZONES LEADING TO UNDESIRABLE VASCULAR PLANTS			▨					
MAY PRODUCE CHLORAMINE CONCENTRATIONS TOXIC TO AQUATIC LIFE		▨	▨	MIDDLE CHARLES				Employ ozonation as a disinfection process

CONCEPT 1

HYGIENIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL / IPSWICH RIVER	SOUTH COASTAL / NORTH RIVER	SUASCO	
A. BENEFICIAL								
DECREASES CONCENTRATIONS OF HAZARDOUS SUBSTANCES IN WATER DUE TO IMPROVED TREATMENT	■			■	■	■	■	
CREATES LESS OF A HEALTH HAZARD WHEN MALFUNCTIONING DUE TO DECREASED FLOW								
ELIMINATES POLLUTION IN AREAS WITH MALFUNCTIONING SUBSURFACE DISPOSAL SYSTEMS	■	■	■	■	■	■	■	
AUGMENTS FLOW CREATING MORE PLEASANT CONDITIONS				■				
DILUTES BACTERIAL CONCENTRATION IN WATER DUE TO EFFLUENT DISCHARGE					■		■	
ELIMINATES POLLUTION FROM INADEQUATE WASTE TREATMENT FACILITIES				■			■	
B. ADVERSE								MITIGATION MEASURES
INCREASES VIRUS CONCENTRATIONS IN WATER DUE TO EFFLUENT DISCHARGE					HAMILTON WENHAM TOPS		SUDBURY	EMPLOY OZONATION AS A DISINFECTION PROCESS
INCREASES NITRATE CONCENTRATIONS IN WATER, STIMULATING ALGAL BLOOMS, UNPLEASANT CONDITIONS AND HAZARDS TO WATER SUPPLIES				▨	HAMILTON WENHAM TOPS	ROCKLAND	HUDSON MARLBOROUGH NORTHBORO WESTBORO MILLBURY CONCORD	DENITRIFICATION OF EFFLUENT TO REMOVE NITRATES
CREATES GREATER HEALTH HAZARD WHEN FACILITY OR COLLECTION SYSTEM IS MALFUNCTIONING (S)	▨	▨	▨	▨	▨	▨	▨	
LOWERS FLOW CAUSING UNPLEASANT CONDITIONS, AND DECREASE IN WATER SUPPLY								
MAY DEGRADE WATER QUALITY DURING CONSTRUCTION (S)	▨	▨	▨	▨	▨	▨	▨	

CONCEPT 2

HYGIENIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH RIVER	SOUTH COASTAL-NORTH RIVER	SUASCO	
A. BENEFICIAL								
DECREASES CONCENTRATIONS OF HAZARDOUS SUBSTANCES IN WATER DUE TO IMPROVED TREATMENT	■			■	■	■	■	
CREATES LESS OF A HEALTH HAZARD WHEN MALFUNCTIONING DUE TO DECREASED FLOW	■							
ELIMINATES POLLUTION IN AREAS WITH MALFUNCTIONING SUBSURFACE DISPOSAL SYSTEMS	■	■	■	■	■	■	■	
AUGMENTS FLOW CREATING MORE PLEASANT CONDITIONS			■	■				
DILUTES BACTERIAL CONCENTRATION IN WATER DUE TO EFFLUENT DISCHARGE			■	■	■		■	
ELIMINATES POLLUTION FROM INADEQUATE WASTE TREATMENT FACILITIES				■			■	
B. ADVERSE								MITIGATION MEASURES
INCREASES VIRUS CONCENTRATIONS IN WATER DUE TO EFFLUENT DISCHARGE			▨	WATERTOWN DEDHAM	HAMILTON MIDDLETON		SUDBURY FRAMINGHAM	EMPLOY OZONATION AS A DISINFECTION PROCESS
INCREASES NITRATE CONCENTRATIONS IN WATER, STIMULATING ALGAL BLOOMS, UNPLEASANT CONDITIONS AND HAZARDS TO WATER SUPPLIES			▨	▨	HAMILTON MIDDLETON	BOXBOROUGH	BILLERICA CONCORD HUDSON FRAMINGHAM HUDSON MARLBORO W.	DENITRIFICATION OF EFFLUENT TO REMOVE NITRATES
CREATES GREATER HEALTH HAZARD WHEN FACILITY OR COLLECTION SYSTEM MALFUNCTIONS		▨	▨	▨	▨	▨	▨	
LOWERS FLOW CAUSING UNPLEASANT CONDITIONS AND DECREASE IN WATER SUPPLY								
MAY DEGRADE WATER QUALITY DURING CONSTRUCTION (S)	▨	▨	▨	▨	▨	▨	▨	

CONCEPT 3

HYGIENIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH RIVER	SOUTH COASTAL-NORTH RIVER	SUASCO	
A. BENEFICIAL								
DECREASES CONCENTRATIONS OF HAZARDOUS SUBSTANCES IN WATER DUE TO IMPROVED TREATMENT								
CREATES LESS OF A HEALTH HAZARD WHEN MALFUNCTIONING DUE TO DECREASED FLOW								
ELIMINATES POLLUTION IN AREAS WITH MALFUNCTIONING SUBSURFACE DISPOSAL SYSTEMS								
AUGMENTS FLOW CREATING MORE PLEASANT CONDITIONS								
DILUTES BACTERIAL CONCENTRATION IN WATER DUE TO EFFLUENT DISCHARGE								
ELIMINATES POLLUTION FROM INADEQUATE WASTE TREATMENT FACILITIES								
B. ADVERSE								MITIGATION MEASURES
INCREASED VIRUS CONCENTRATIONS IN WATER DUE TO EFFLUENT DISCHARGE					HAMILTON WENHAM		SUDBURY	EMPLOY OZONATION AS A DISINFECTION PROCESS
INCREASES NITRATE CONCENTRATIONS IN WATER, STIMULATING ALGAL BLOOMS AND UNPLEASANT CONDITIONS					HAMILTON WENHAM	ACTON	BOLTON CONCORD SUDBURY HUDSON MARLBOROUGH	DENITRIFICATION TO REMOVE FROM EFFLUENT
CREATES GREATER HEALTH HAZARD WHEN FACILITY OR COLLECTION SYSTEM IS MALFUNCTIONING								
LOWERS FLOW CAUSING UNPLEASANT CONDITIONS AND DECREASE IN WATER SUPPLY								
MAY DEGRADE WATER QUALITY DURING CONSTRUCTION (S)								

CONCEPT 4

HYGIENIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL IPSWICH RIVER	SOUTH COASTAL NORTH RIVER	SUASCO	
A. BENEFICIAL								
DECREASES CONCENTRATIONS OF HAZARDOUS SUBSTANCES IN WATER DUE TO IMPROVED TREATMENT	■			■	■	■	■	
CREATES LESS OF A HEALTH HAZARD WHEN MALFUNCTIONING DUE TO DECREASED FLOW	■							
ELIMINATES POLLUTION IN AREAS WITH MALFUNCTIONING SUBSURFACE DISPOSAL SYSTEMS	■	■	■	■	■	■	■	
AUGMENTS FLOW CREATING MORE PLEASANT CONDITIONS		■	■	■				
DILUTES BACTERIAL CONCENTRATION IN WATER DUE TO EFFLUENT DISCHARGE		■	■	■	■		■	
ELIMINATES POLLUTION FROM INADEQUATE WASTE TREATMENT FACILITIES				■			■	
B. ADVERSE								MITIGATION MEASURES
INCREASES VIRUS CONCENTRATIONS IN WATER DUE TO EFFLUENT DISCHARGE		▨	▨	WATERTOWN DEDHAM	HAMILTON MIDDLETON		SUDBURY FRAMINGHAM	EMPLOY OZONATION AS A DISINFECTION PROCESS
INCREASES NITRATE CONCENTRATION IN WATER, STIMULATING ALGAL BLOOMS AND UNPLEASANT CONDITIONS		▨	▨		HAMILTON MIDDLETON	▨	SUDBURY CONCORD SUDBURY FRAMINGHAM HUDSON MARLBORO W.	DENITRIFICATION OF EFFLUENT TO REMOVE NITRATE
CREATES GREATER HEALTH HAZARD WHEN COLLECTION SYSTEM OR FACILITY IS MALFUNCTIONING		▨	▨	▨	▨	▨	▨	
LOWERS FLOW CAUSING UNPLEASANT CONDITIONS AND DECREASE IN WATER SUPPLY								
MAY DEGRADE WATER QUALITY DURING CONSTRUCTION (S)	▨	▨	▨	▨	▨	▨	▨	

CONCEPT 5 HYGIENIC IMPACTS						
IMPACTS	LAKEVILLE FREETOWN	FALL RIVER FREETOWN	PLYMOUTH CARVER	BOURNE E.	BOURNE W.	
A. BENEFICIAL						
REDUCES TREATMENT FACILITY FLOW AND POTENTIAL THREAT OF POLLUTION IN BOSTON HARBOR						
SOIL PROVIDES BETTER REMOVAL OF HAZARDOUS SUBSTANCES THAN ADVANCED TREATMENT						
B. ADVERSE						MITIGATION MEASURES
POSSIBLE CONTAMINATION OF AIR BY AEROSOL-BORNE PATHOGENS						
POSSIBLE BREEDING OF VECTORS OF DISEASE AND NUISANCES						CAREFUL MONITORING AND MAINTENANCE OF SITES
MAY CONTAMINATE RECREATION AREAS AND WATER SUPPLY IF THERE IS BREAKDOWN IN THE SOILS REMOVAL EFFICIENCY						CAREFUL MONITORING AND MAINTENANCE OF SITES
MAY CONTAMINATE CRANBERRY BOGS						
CAUSES POLLUTION HAZARDS WHEN MALFUNCTIONING DUE TO LONG TRANSMISSION LINES (S)						
MAY DEGRADE WATER QUALITY DURING CONSTRUCTION (S)						

"RECOMMENDED PLAN"

HYGIENIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH RIVER	SOUTH COASTAL-NORTH RIVER	SUASCO	
A. BENEFICIAL								
DECREASES CONCENTRATIONS OF HAZARDOUS SUBSTANCES IN WATER DUE TO IMPROVED TREATMENT								
CREATES LESS OF A HEALTH HAZARD WHEN MALFUNCTIONING DUE TO DECREASED FLOW								
ELIMINATES POLLUTION IN AREAS WITH MALFUNCTIONING SUBSURFACE DISPOSAL SYSTEMS								
AUGMENTS FLOW CREATING MORE PLEASANT CONDITIONS								
DILUTES BACTERIAL CONCENTRATION IN WATER DUE TO EFFLUENT DISCHARGE								
ELIMINATES POLLUTION FROM INADEQUATE WASTE TREATMENT FACILITIES								
B. ADVERSE								MITIGATION MEASURES
INCREASES VIRUS CONCENTRATIONS IN WATER DUE TO EFFLUENT DISCHARGE				MIDDLE CHARLES				EMPLOY OZONATION AS A DISINFECTION PROCESS
INCREASES NITRATE CONCENTRATIONS IN WATER, STIMULATING ALGAL BLOOMS AND UNPLEASANT CONDITIONS				MIDDLE CHARLES				DENITRIFICATION OF EFFLUENTS TO REMOVE NITRATES
CREATES GREATER HEALTH HAZARD WHEN FACILITY OR COLLECTION SYSTEM IS MALFUNCTIONING								
LOWERS FLOW CAUSING UNPLEASANT CONDITIONS, AND DECREASE IN WATER SUPPLY								
MAY DEGRADE WATER QUALITY DURING CONSTRUCTION (S)								

CONCEPT 1
SOCIO-ECONOMIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH R.	SOUTH COASTAL-NORTH R.	SUASCO	
A. BENEFICIAL								
STIMULATES GROWTH AND DEVELOPMENT THROUGH EXTENSION OF INTERCEPTORS								
PROMOTES HIGH INTENSITY USE ALONG INTERCEPTOR CORRIDORS								
PROMOTES DEVELOPMENT OF RIVER BASINS DUE TO CLEAN-UP								
TRIGGERS RESIDENTIAL GROWTH								
CREATES BETTER COMMUNITY HEALTH								
SATISFIES HOUSING DEMAND								
MITIGATES REASONS AGAINST CONSTRUCTION OF LOW AND MODERATE INCOME HOUSING								
STIMULATES RECREATION DUE TO IMPROVED WATER QUALITY AND/OR INCREASED FLOW								
INCREASES COMMERCIAL ACTIVITY AND RECREATION-RELATED SERVICES								
LEAST COST								
B. ADVERSE								MITIGATION MEASURES
ENCROACHMENT OF SEWERS ON WETLANDS								
INCREASES LAND VALUES DUE TO EXTENSION OF INTERCEPTORS								
REDUCES FORESTED AREAS AND INCREASES RUNOFF								
INCREASES COSTS TO PAPER INDUSTRY								
CAUSES CONFLICT WITH POTENTIAL OPEN SPACE AND RECREATIONAL USE								
MOST COST-LARGEST INCREASE IN LOCAL TAXES								
CONFLICT WITH LAND USE								ALTERNATIVE SITING OR CAREFUL DESIGN

CONCEPT 2
SOCIO-ECONOMIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH R.	SOUTH COASTAL-NORTH R.	SUASCO	
A. BENEFICIAL								
STIMULATES GROWTH AND DEVELOPMENT THROUGH EXTENSION OF INTERCEPTORS								
PROMOTES HIGH INTENSITY USED ALONG INTERCEPTOR CORRIDORS								
PROMOTES DEVELOPMENT OF RIVER BANKS DUE TO CLEAN-UP								
TRIGGERS RESIDENTIAL GROWTH								
CREATES BETTER COMMUNITY HEALTH								
SATISFIES HOUSING DEMAND								
MITIGATES REASONS AGAINST CONSTRUCTION OF LOW AND MODERATE INCOME HOUSING								
STIMULATES RECREATION DUE TO IMPROVED WATER QUALITY AND/OR INCREASED FLOW							CONCORD BILLERICA	
INCREASES COMMERCIAL ACTIVITY AND RECREATION-RELATED SERVICES								
LEAST COST								
B. ADVERSE								MITIGATION MEASURES
ENCROACHMENT OF SEWERS ON WETLANDS				MEDFIELD MEDWAY MILFORD				
INCREASES LAND VALUES DUE TO EXTENSION OF INTERCEPTORS				MEDFIELD MEDWAY MILFORD				
REDUCES FORESTED AREAS AND INCREASES RUNOFF				MEDFIELD MEDWAY MILFORD				
INCREASES COSTS TO PAPER INDUSTRY								
CAUSES CONFLICT WITH OPEN SPACE AND RECREATIONAL USE				MEDWAY MEDFIELD MILFORD	GLOUCESTER/ITY		NORTON MARLBORO & HUDSON	
MOST COST, LARGEST INCREASE IN LOCAL TAXES								
CONFLICT WITH LAND USE				MEDWAY MEDFIELD DEDHAM	ESSEX ROCKPORT HAMILTON GLOUCESTER & GLOUCESTER/ITY LYNN	MANSFIELD NORFOLK DEDHAM	NORTON HUDSON	ALTERNATIVE SITING OR CAREFUL DESIGN

CONCEPT 3
SOCIO-ECONOMIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH R.	SOUTH COASTAL-NORTH R.	SUASCO	
A. BENEFICIAL								
STIMULATES GROWTH AND DEVELOPMENT THROUGH EXTENSION OF INTERCEPTORS								
PROMOTES HIGH INTENSITY USE ALONG INTERCEPTOR CORRIDORS								
PROMOTES DEVELOPMENT OF RIVER BANKS DUE TO CLEAN-UP								
TRIGGERS RESIDENTIAL GROWTH								
CREATES BETTER COMMUNITY HEALTH								
SATISFIES HOUSING DEMAND								
MITIGATES REASONS AGAINST CONSTRUCTION OF LOW AND MODERATE INCOME HOUSING								
STIMULATES RECREATION DUE TO IMPROVED WATER QUALITY AND/OR INCREASED FLOW								
INCREASES COMMERCIAL ACTIVITY AND RECREATION-RELATED SERVICES								
LEAST COST								
B. ADVERSE								MITIGATION MEASURES
ENCROACHMENT OF SEWERS ON WETLANDS								
INCREASES LAND VALUE DUE TO EXTENSION OF INTERCEPTORS								
REDUCES FORESTED AREAS AND INCREASES RUNOFF								
INCREASES COSTS TO PAPER INDUSTRY								
CAUSES CONFLICT WITH OPEN SPACE AND RECREATIONAL USE								
MOST COST; LARGEST INCREASE IN LOCAL TAXES								
CONFLICT WITH LAND USE								ALTERNATIVE SITING OR CAREFUL DESIGN

CONCEPT 4
SOCIO-ECONOMIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH R.	SOUTH COASTAL-NORTH R.	SUASCO	
A. BENEFICIAL								
STIMULATES GROWTH AND DEVELOPMENT THROUGH EXTENSION OF INTERCEPTORS								
PROMOTES HIGH INTENSITY USE ALONG INTERCEPTOR CORRIDORS								
PROMOTES DEVELOPMENT OF RIVER BANKS DUE TO CLEAN-UP								
TRIGGERS RESIDENTIAL GROWTH								
CREATES BETTER COMMUNITY HEALTH								
SATISFIES HOUSING DEMAND								
MITIGATES REASONS AGAINST CONSTRUCTION OF LOW AND MODERATE INCOME HOUSING								
STIMULATES RECREATION DUE TO IMPROVED WATER QUALITY AND/OR INCREASED FLOW								
INCREASES COMMERCIAL ACTIVITY AND RECREATION-RELATED SERVICES								
LEAST COST								
B. ADVERSE								MITIGATION MEASURES
ENCROACHMENT OF SEWERS ON WETLANDS								
INCREASES LAND VALUES DUE TO EXTENSION OF INTERCEPTORS								
REDUCES FORESTED AREAS AND INCREASES RUNOFF								
INCREASES COSTS TO PAPER INDUSTRY								
CAUSES CONFLICT WITH OPEN SPACE AND RECREATIONAL USE								
MOST COST; LARGEST INCREASE IN LOCAL TAXES								
CONFLICT WITH LAND USE								ALTERNATIVE SITING OR CAREFUL DESIGN

CONCEPT 5
SOCIO-ECONOMIC IMPACTS *

IMPACT	LAKEVILLE-FREETOWN	FALL RIVER FREETOWN	PLYMOUTH-CARVER	BOURNE E.	BOURNE W.	
A. BENEFICIAL						
INCREASES PRODUCTIVITY OF AFFECTED LAND, WHICH COULD POTENTIALLY BE USED TO GROW FORAGE CROPS						
B. ADVERSE						MITIGATION MEAS.
MAY CONTAMINATE PUBLIC WATER SUPPLIES						
MAY DAMAGE CRANBERRY BOGS						
MAY DECREASE USE OF RECREATION AREAS DUE TO ADVERSE PUBLIC ATTITUDES						
CAUSES TAX LOSS TO COMMUNITIES BY REMOVING LAND FROM HOUSING MARKET						
LACKS LOCAL BENEFITS						

* IMPACTS INSIDE BH-EMMA AREA SAME AS CONCEPT 4.

"RECOMMENDED PLAN"
SOCIO-ECONOMIC IMPACTS

IMPACT	BOSTON HARBOR	MYSTIC RIVER	NEPONSET RIVER	CHARLES RIVER	NORTH COASTAL-IPSWICH R.	SOUTH COASTAL-NORTH R.	SUASCO	
A. BENEFICIAL								
STIMULATES GROWTH AND DEVELOPMENT THROUGH EXTENSION OF INTERCEPTORS				■				
PROMOTES HIGH INTENSITY USE ALONG INTERCEPTOR CORRIDORS								
PROMOTES DEVELOPMENT OF RIVER BANKS DUE TO CLEAN-UP				■				
TRIGGERS RESIDENTIAL GROWTH								
CREATES BETTER COMMUNITY HEALTH				■				
SATISFIES HOUSING DEMAND				■				
MITIGATES REASONS AGAINST CONSTRUCTION OF LOW AND MODERATE INCOME HOUSING				■				
STIMULATES RECREATION DUE TO IMPROVED WATER QUALITY AND/OR INCREASED FLOW	■	■	■	■				
INCREASES COMMERCIAL ACTIVITY AND RECREATION-RELATED SERVICES	■	■	■	■				
LEAST COST								
B. ADVERSE								MITIGATION MEASURES
ENCROACHMENT OF SEWERS ON WETLANDS				▨				
REDUCES FORESTED AREAS AND INCREASES RUNOFF				▨				
INCREASES LAND VALUES DUE TO EXTENSION OF INTERCEPTORS				▨				
INCREASES COST TO PAPER INDUSTRY	▨	▨	▨	▨				
CAUSES CONFLICT WITH OPEN SPACE AND RECREATIONAL USE			▨	▨				
MOST COST; LARGEST INCREASE IN LOCAL TAXES								
CONFLICT WITH LAND USE		▨	▨	▨				ALTERNATIVE SITING OR CAREFUL DESIGN

H. IMPACT EVALUATION

Impact evaluation is the determination of change resulting from the implementation of a specific engineering alternative as beneficial, adverse, or neutral (and making trade-offs amongst these changes) in accordance with community goals and objectives, expressed in planning objectives, as well as with Federal objectives expressed in the Water Resource Council's Principles and Standards.

1. Contribution to Planning Objectives

Planning objectives for the Boston Harbor-Eastern Massachusetts Metropolitan Area study are listed in Section D. The following pages discuss contributions of the study's plans to the various planning objectives (national, regional and specific study objectives).

a. National Objectives

Although the Boston Harbor-Eastern Massachusetts Metropolitan Area Wastewater Management Study was authorized and initiated prior to the passage of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) in October 1972, the technical subcommittee recognized the passage of the Act and attempted to address its goals and objectives through compliance with the requirements of Section 201 of the Act.

The following paragraphs discuss the study's compliance with the overall goals of PL 92-500 and Section 201.

National Goals as established in PL 92-500

(1) "The discharge of pollutants into navigable waters be eliminated by 1985."

The Boston Harbor-Eastern Massachusetts Metropolitan Area Wastewater Management Study has not investigated the full implications of this goal. However, the study has recognized compliance with Section 201 of the Act as a step toward achievement of this goal.

(2) "Wherever attainable, an interim goal of water quality which provides for protection and propogation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983."

The recommended construction program of facilities in the Eastern Massachusetts Metropolitan Area was formulated to address the water quality and waste treatment needs of the region.

The Recommended Plan should provide water quality which will provide for protection and propogation of fish, shellfish and wildlife and provide for recreation in and on the water through its compliance with Section 201 of the Act. The study's recommended construction program (see Appendix G) proposes that the study area's water quality and waste treatment needs be met by 1983. Management of combined sewer overflows and treatment facility sludge and correction of infiltration inflow problems are given equal priority with initiation of secondary treatment at the two Boston Harbor treatment facilities, as it was a study finding that correction of combined sewer, storm water and sludge pollution will have a greater beneficial impact on the water quality of the harbor than the implementation of secondary treatment.

Requirements of Section 201 of PL 92-500

(1) "Waste treatment management plans and practices shall provide for the application of the best practicable waste treatment technology before any discharge into receiving waters, including reclaiming and recycling of water...and shall provide for consideration of advanced waste treatment techniques."

Treatment facilities proposed in all the alternatives and the Recommended Plan for the Eastern Massachusetts Metropolitan Area were formulated to provide a minimum of best practicable waste treatment as defined by the U.S. Environmental Protection Agency. In addition all facilities proposed to discharge to fresh water were formulated to provide advanced waste treatment through addition of phosphorus removal and nitrification to secondary treatment. The Recommended Plan proposes two major advanced waste treatment facilities which will recycle water to the Charles and Neponset Rivers.

(2) "To the extent practicable, waste treatment management shall be on an areawide basis."

All plans were formulated on an areawide basis. One hundred and nine cities and towns in Eastern Massachusetts were considered in the determination of the maximum size of the Metropolitan Sewerage District. The Recommended Plan increases the Metropolitan Sewerage District from its current 43 members to 51, and contains 4 "regional" treatment facilities.

(3) "Encourage waste treatment management which results in the construction of revenue producing facilities providing for the recycling of potential sewage pollutants through the production of agriculture, silvaculture, or aquaculture products, or any combination thereof."

The land-oriented concept, Concept 5, provided for the treatment of 187 MGD of sewage from the Eastern Massachusetts Metropolitan Area by land application in Southeastern Massachusetts. Part of this land system would have provided for production of agriculture and/or silvaculture products.

(4) "Encourage waste treatment management which results in integrating facilities for sewage treatment and recycling with facilities to treat, dispose of, or utilize other industrial and municipal wastes, including but not limited to solid waste and waste heat and thermal discharges..."

The opportunity exists to integrate the disposal of municipal and industrial solid waste with the treatment and disposal of sludge from the satellite facilities. Such opportunities will be considered by the Metropolitan District Commission before grant application for satellite facilities.

(5) "Encourage waste treatment management which combines "open space" and recreational considerations with such management."

The land application portions of Concept 5 would have acted to preserve "open space" upon implementation. It was envisioned that recreation could have been integrated with the land treatment system. Both the Recommended Plan and the construction program recognize the importance of recreation through proposals to (1) return treated wastewater to the Charles and Neponset Rivers, thus alleviating unpleasant low flow conditions in these rivers and (2) to control combined sewer overflow and eliminate sludge disposal to recreational waters of Boston Harbor.

The output of the study will constitute a facilities plan (step 1 of the construction grant process authorized by PL 92-500).

b. Specific Study Objectives

Figure 10 displays each specific study objective, and the corresponding tasks performed by the study (along with references to Technical Data Volumes) to accomplish these objectives.

FIGURE 10

RELATIONSHIP OF STUDY TASKS TO SPECIFIC PLANNING OBJECTIVES

Specific Study Objectives	Study Task
a. To develop recommendations for the management of wastewater in Eastern Massachusetts up to the year 2050.	Four water-oriented and one land-oriented wastewater management alternatives were developed for the Boston Harbor-Eastern Massachusetts Metropolitan Area Study Area (Technical Data Volumes 4 and 5). Plans for Management of Combined Sewer Overflows (Volume 7), Stormwater (Volume 8) and Financing and Management (Volume 12) were also developed.
b. To determine the ultimate growth or contraction of the Metropolitan Sewerage District (MSD) to the year 2050. All engineering, economic, and environmental aspects to be considered, including the river basin concept.	Engineering alternatives ranged from a highly centralized system with maximum expansion of the current Deer and Nut Island treatment facilities to serve 58 communities to a decentralized system with contraction of the current Deer and Nut Island facilities service area and establishment of 6 satellite regional systems on river's tributary to Boston Harbor. Biological, aesthetic, hygienic, and socio-economic impacts of these alternatives are presented in Technical Data Volume 13.
c. To make recommendations for a management organization for the MSD and its subregional districts as may be projected. Administrative structure, policies, financial arrangements, and related management matters to be considered.	Recommendations for management organization are presented in Financing and Management, Technical Data Volume 12.

FIGURE 10 (Cont'd)

Specific Study Objectives	Study Task
d. To determine facilities required for the collection, treatment and disposal of existing and future MSD sewage flows including the preparation of preliminary engineering designs for the recommended method of treatment for the Deer Island and Nut Island projected sewage flows.	Analyses and recommended improvements of Deer and Nut Island treatment facilities are presented in Technical Data Volumes 10 and 11.
e. To make recommendations for the regulation of combined sewage overflows, infiltration, and stormwater with respect to both the MSD system and the systems of its member communities.	Recommendations for regulation of combined sewage overflow, stormwater and infiltration are presented in Technical Data Volumes 7, 8 and 9.
f. To undertake an industrial waste survey and inventory including developing industrial waste regulations and an equitable cost recovery systems.	An industrial waste survey of 5 categories of industries within the study area was completed and a sewer use ordinance and equitable cost recovery system was developed from this information. (See Technical Data Volumes 3 and 12, respectively).
g. To determine the feasibility of reclamation and reuse of wastewater and treated water.	Reclamation and reuse of wastewater was considered both in Concept 5, the land-oriented concept, and in decentralized concepts, where treated wastewater would be returned to its basin of origin.
h. To develop short-range construction programs and detailed plans for facilities required by the year 2000.	Construction programs and detailed plans for facilities recommended by the study are presented in Recommended Plan and Implementation Program, Technical Data Volume 15.

FIGURE 10 (cont'd)

Specific Study Objectives	Study Task
i. To develop a public participation program throughout the duration of the study.	The study's public participation program is discussed in Technical Data Volume 14.
j. To meet the requirements of Section 201 of Public Law 92-500.	See discussion of National Goals.

c. Regional Goals and Objectives

Regional goals, objectives and policies were addressed from the start of the study as part of the input to the EMPIRIC Land Use Allocation Model used to develop projections of population, employment and land use for the study area. These projections were used in development of the five engineering alternatives as well as in plans for management of combined sewage overflow and stormwater.

More specifically, the Housing objectives (see Appendix B) of (1) adsorption of average residential densities on vacant land to encourage a range of housing types, and (2) encouragement of adequate facilities and services as required to meet population needs, were addressed in all engineering alternatives through the recommendation that sewerage be at least partially provided to all 109 communities by the year 2000 to meet the needs of the projected population and residential densities. Waste treatment facilities proposed in all alternatives were designed to adequately handle flows resulting from population and residential density projections. The decentralized concepts appear to realize this objective more fully as they propose return of treated wastewater to its basin of origin, therefore, partially fulfilling increased water supply and water-based recreation needs required by a larger population in areas outside the Boston core area.

Both stormwater and combined sewer overflow plans were designed to accommodate a larger population. Larger population may result in replacement of forested lands by residential areas, and thus increase surface runoff into the study area's rivers.

Economic goals of (1) provision of industrial and commercial space by 1990 to aid in the expansion and modernization of those industrial and business firms already existing in the area, (2) adoption of medium-size industrial parks in new or growing portions of the Metropolitan Boston Area, (3) encouragement of further expansion of regional shopping centers in areas outside the core, (4) encouragement of major new industrial development only in areas outside the core, and (5) encouragement of major new industrial development only in areas provided with public sewer facilities, were addressed through the provision, in all engineering alternatives, of sewerage to all 109 communities to accommodate industrial and commercial expansion. Proposed interceptors and treatment facilities were designed to meet flow requirements of increased industrial and commercial activity in outlying areas.

The economic goal of maintenance of the core as a center of economic activity with the objective of retaining about 35 per cent of the regions total employment by 1990 is addressed through the study's proposals for improvement and renovation of existing MDC interceptors, pumping stations and treatment facilities (see Technical Data Volumes 9-11).

The study's alternative plans address nearly all Environmental objectives through its compliance with both Section 201 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500), and specific study objectives (see Figure 10).

d. Response to Public Concerns

Major public concerns elicited through the public participation program were:

(1) Desire for maintenance of river basin integrity and decentralization of wastewater treatment.

(2) Desire for low density development and continued reliance on individual on-lot disposal systems in outlying towns.

(3) Interest in land treatment and other methods for recycling wastewater.

(4) Apprehension over local impacts of treatment facilities.

The study recognized the citizens' preference for decentralization through two alternative proposals for decentralized wastewater management systems (Concepts 2 and 4). The Recommended Plan proposes reduction of the present Deer and Nut Island facilities service areas, and establishment of two sizeable advanced waste treatment facilities on the Charles and Neponset Rivers.

The citizens' desire for continued reliance on individual on-lot disposal systems in outlying areas was addressed early in the study through proposals, in all alternative concepts, that outlying towns with low population density, such as Stow, Sherborn and Dover, remain unsewered until the year 2000 or later.

The public's interest in land treatment methods was acknowledged in the proposal of a land-oriented treatment alternative, Concept 5.

Most proposed land application sites were located in southeastern Massachusetts outside the study area due to lack of suitable and available land within the Boston Harbor-Eastern Massachusetts Metropolitan Area. Negative response elicited by this alternative from residents of southeastern Massachusetts led, in part, to its rejection by the study's Technical Subcommittee as a feasible alternative for wastewater management.

Citizens in areas directly affected by treatment facilities and effluent discharges expressed anxiety over negative impacts on environmental quality and socio-economic factors such as land value. As mentioned above, citizen concern played a major role in the rejection

of the land-oriented alternative. The Technical Subcommittee agreed to allow citizens of the Wellesley area to participate in the site selection of the Wellesley area treatment facility. Further efforts are needed in other affected areas before complete acceptance of the Recommended Plan can be accomplished.

2. Contribution to Federal Objectives

The Water Resources Council's Principles and Standards place environmental concerns on a basis equal to economic development in Federal resource planning projects. In addition to considering objectives of national economic development (NED) and environmental quality (EQ), Principles and Standards require planners to display beneficial and adverse effects on regional development (RD) and social well being (SWB), where appropriate, to give further assistance to the decision maker. Concerns of RD and SWB are overall goals, and do not pull as much weight in the decision-making process as do the objectives of NED and EQ, which form the basis for the trade-off analysis between alternative plans.

A description of the four Federal objectives and goals is given below:

a. National Economic Development (NED)

Beneficial Effects:

(1) The value of increased outputs of goods and services. Examples include:

(a) Flood control
(b) Power
(c) Water supply
(d) Irrigation
(e) Recreation
(f) Use of labor resources otherwise unemployed or underemployed in construction of installation of the plan.

(2) The value of output resulting from external economies. Examples include:

(a) Economies of scale in subsequent processing
(b) Reduced transportation costs as a result of road relocation

Adverse Effects:

(1) The value of resources required for a plan. Examples include:

(a) Project construction and operation, maintenance and replacement
(b) Project pumping power
(c) Labor resources displaced and subsequently unemployed

(2) Losses in output resulting from external diseconomies, or increases in costs. Examples include:

(a) Diseconomies of scale in subsequent processing for displaced activities
(b) Increased transportation costs as a result of road relocation

b. Environmental Quality (EQ)

Beneficial and Adverse Effects on:

(1) Open and green space, wild and scenic rivers, lakes, beaches, shores, mountains and wilderness areas, estuaries and other areas of natural beauty.

(2) Archeological, historical, biological and geological resources and selected ecological systems.

(3) The quality of water, land and air resources.

(4) Irreversible commitments of resources to future uses.

c. Regional Development (RD)

Beneficial Effects:

(1) Income

(a) The value of increased outputs of goods and services from a plan to the users residing in the region under consideration.
(b) The value of output to the region resulting from external economies.

(2) Employment

(a) Increase in number and type of jobs resulting from a plan in the region under consideration.

(3) Improvements related to population distribution

(4) Enhancement of the regional economic base and economic stability

(5) Improvement in environmental conditions of special regional concern

Adverse Effects:

(1) Income

(a) The value of resources contributed to from within the region under consideration to achieve the outputs of a plan.

(b) Loss of assistance payments from sources outside the region to otherwise unemployed or underemployed resources and displaced resources residing in the region under consideration.

(2) Employment

(a) Decreased in number and types of jobs resulting from a plan in the region under consideration.

(3) Adverse effects related to population distribution

(4) Detriment to regional economic base and economic stability

(5) Degradation of environmental conditions of special regional concern

d. Social Well-Being (SWB)

Beneficial and Adverse Effects on:

(1) Real income distribution

(2) Life, health and safety

(3) Educational, cultural and recreational opportunities

(4) Emergency preparedness

The study's contributions to all four Federal goals is displayed on the following pages. Each table displays beneficial or adverse effects of the six alternatives on one of the Federal goals.

The "Recommended Plan" does not include a wastewater management alternative for peripheral towns. To ensure that all concepts receive equitable evaluation, impacts related to treatment facilities and collection systems serving peripheral towns proposed in Concepts 1-5 are not included in these tables.

IMPACT OF ALTERNATIVE PLANS ON NATIONAL ECONOMIC DEVELOPMENT

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Beneficial						
Increased output of goods & services	Increases commercial activity & recreation related services	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1 Increases productivity of land, which could potentially be used to grow forage crops (market value $1.6M to private farmers).	Same as Concept 1
Adverse						
Increased costs to industry	Product prices in 5 major industrial categories will increase slightly due to added treatment costs. Paper industry will experience the highest (8.6%) percentage increase in prices.	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1

IMPACT OF ALTERNATIVE PLANS ON NATIONAL ECONOMIC DEVELOPMENT (Cont'd)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Value of resources required for a plan	*Capital Cost $726M	Capital Cost = $731M	Capital Cost = $825M	Capital Cost = $798M	Capital Cost = $825M	Capital Cost = $735M
	*Annual O & M Cost = $21M	Annual O&M Cost = $39M	Annual O&M Cost = $18M	Annual O&M Cost = $47M	Annual O&M Cost = $21M	Annual O&M Cost = $29M

* Costs do not include peripheral systems.

IMPACT OF ALTERNATIVE PLANS ON ENVIRONMENTAL QUALITY

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Beneficial						
Open and green space, lakes, beaches		2 sites preserve and enhance open space		Same as Concept 2	Requires removal or relocation of minor streams running through land application sites	
Archeological, historical, biological and geological resources	Creates a more stable aquatic environment due to flow augmentation and higher DO levels on the Upper Charles River	Creates a more stable aquatic environment due to flow augmentation and higher DO levels on the Upper Charles, Sudbury and Neponset Rivers		Creates a more stable aquatic environment due to flow augmentation and higher DO levels on the Upper Charles, Sudbury, Neponset and Aberjona Rivers	Creates a more stable aquatic environment due to flow augmentation and higher DO levels on the Upper Charles and Sudbury Rivers	Creates a more stable aqautic environment due to flow augmentation and higher DO levels on the Upper Charles, Neponset and Aberjona Rivers

IMPACT OF ALTERNATIVE PLANS ON ENVIRONMENTAL QUALITY (Cont'd)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
The quality of water, land and air resources						
	Improves water quality in Boston Harbor	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1	**Same as Concept 1**
	Eliminates non point sources of pollution	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1
	May reduce stimulus to evtrophication on the Upper Charles	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1
	1 facility site is visually compatible with surrounding development and land form	2 facility sites are visually compatible with surrounding development and land form		Same as Concept 2	Same as Concept 2	Same as Concept 1

IMPACT OF ALTERNATIVE PLANS ON ENVIRONMENTAL QUALITY (cont'd)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
					Provides water to a dry area, increasing vegetative growth and variety, and groundwater levels in southeastern Mass.	
Adverse						
Open and green space, lakes		Reduces shore zones on Neponset River, leading to undesirable vascular plants		Same as Concept 2		Same as Concept 2
Archeological historical, biological and geological resources		2 facilities visually intrude on marshlands		2 facilities visually intrude on marshlands	Same as Concept 4	Same as Concept 4

IMPACT OF ALTERNATIVE PLANS ON ENVIRONMENTAL QUALITY (Cont'd)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Archeological, historical, biological & geological resources(cont.)	2 facilities disrupt surrounding ecology	4 facilities disrupt surrounding ecology	2 facilities disrupt surrounding ecology	3 facilities disrupt surrounding ecology	Same as Concept 4	Same as Concept 4
	Encroachment of sewers on wetlands along Charles	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1
		Produces chloramine concentrations toxic to aquatic life on Neponset, Middle Charles and Sudbury Rivers		Produces chloramine concentrations toxic to aquatic life on Mystic, Aberjona, Neponset, Middle Charles, and Sudbury Rivers		Produces chloramine concentrations toxic to aquatic life on Aberjona, Neponset and Middle Charles Rivers
	Disrupts historical landmarks on Deer Island	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1

IMPACT OF ALTERNATIVE PLANS ON ENVIRONMENTAL QUALITY (Cont'd)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
			Creates less suitable habitat for aquatic life on Charles River due to flow reduction. May damage cranberry bogs.			
The quality of water, land, and air resources		Stimulates eutrophication on Neponset, Middle Charles and Sudbury Rivers		Stimulates eutrophication on Mystic, Aberjona, Neponset, Middle Charles and Sudbury Rivers	May damage cranberry bogs	Stimulates eutrophication on Aberjona, Neponset, Middle Charles Rivers
	Degrades water quality due to decrease in forested land and increased runoff	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1
					Large storage lagoons for land application sites are visually in-	

IMPACT OF ALTERNATIVE PLANS ON ENVIRONMENTAL QUALITY (Cont'd)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
The quality of water, land & air resources (cont.)					May degrade local surface or ground-water supplies in event of system mal-function	
	3 facilities are visually incompatible with surround-ing develop-ment and land-form	5 facilities are visually incompatible with surround-ing develop-ment and land-form	2 facilities are visually incompatible with surround-ing develop-ment and land-form	5 facilities are incompat-ible with surrounding development and land-form	5 facilities are incompat-ible with surrounding development and land-form Possible con-tamination of air by aerosol-borne pathogens May damage large areas of vegetation in event of system mal-function	4 facilities are incompat-ible with surrounding development and land-form

IMPACT OF ALTERNATIVE PLANS ON ENVIRONMENTAL QUALITY (Cont'd)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Irreversible commitment of resources	Deer and Nut Island facilities discharge 555 MGD of potentially recycleable waste water to Boston Harbor (year 2000)	Deer and Nut Island facilities discharge 435 MGD of potentially recycleable waste water to Boston Harbor (year 2000)	Deer and Nut Island facilities discharge 575 MGD of potentially recycleable waste water to Boston Harbor (year 2000)	Deer and Nut Island facilities discharge 385 MGD of potentially recycleable waste water to Boston Harbor (year 2000)	Same as Concept 4 Removes much used woodland Prohibits highway expansion	Deer and Nut Island facilities discharge 500 MGD of potentially recycleable waste water to Boston Harbor (year 2000)

IMPACT OF ALTERNATIVE PLANS ON REGIONAL DEVELOPMENT

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Beneficial						
Quantity of increased employment	Increased construction employment of 52,680 man-months for Deer and Nut Islands and satellite facilities	Increased construction employment of 72,980 man-months for Deer and Nut Islands and satellite facilities	Increased construction employment of 55,200 man-months for Deer and Nut Islands and satellite facilities	Increased construction employment of 72,705 man-months for Deer and Nut Islands and satellite facilities	Same as Concept 4	Increased construction employment of 62,830 man-months for Deer & Nut Islands & satellite facilities
	Creates least O & M jobs			Creates the most O & M jobs	Same as Concept 4	
Desirable population distribution		Canton facility creates population distribution consistent with regional and local development proposals				Same as Concept 2

IMPACT OF ALTERNATIVE PLANS ON REGIONAL DEVELOPMENT (Cont'd)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Desirable population distribution (cont.)	Extension of interceptors encourages growth of population and development in Charles and SUASCO watersheds with trend toward lower population densities in core area	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1
					Is compatible with plans for expansion of public open space	
Adverse						
Value of income lost	Least decrease in personal income due to increased taxes			Largest decrease in personal income due to increased taxes	Same as Concept 4	

IMPACT OF ALTERNATIVE PLANS ON REGIONAL DEVELOPMENT (Cont'd)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Value of income lost (cont.)					Withdraws land from housing market	
Quantity of jobs lost	155 industrial jobs will be lost due to added treatment costs	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1	Same as Concept 1
Undesirable population distribution	2 facilities are incompatible with regional and local development proposals	Same as Con cept 1		Same as Concept 1	Same as Concept 1	Same as Concept 1

IMPACT OF ALTERNATIVE PLANS ON SOCIAL WELL-BEING

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Beneficial Enhancement of health, safety and community well-being	Creates better community health through elimination of non-point source, pollution and presently inadequate waste treatment facilities	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1
	Improves quality of shellfish harvesting and recreational areas in coastal waters due to improved waste treatment	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1
		Augments flow of Neponset and Charles, creating more pleasant conditions		Augments flow of Neponset, Charles and Mystic, creating more pleasant conditions		same as Concept 4

IMPACT OF ALTERNATIVE PLANS ON SOCIAL WELL-BEING (cont.)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Enhancement of health, safety & community well-being (cont.)	Extension of interceptors will help to satisfy housing demand in Charles and SUASCO watersheds	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1
	Availability of sewers with mitigate reasons against construction of low and moderate income housing	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1
					Soil provides better removal of hazardous substances than advanced treatment	

IMPACT OF ALTERNATIVE PLANS ON SOCIAL WELL-BEING (cont.)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Increases in educational, cultural and recreational opportunities	Increases recreational opportunities due to improved water quality and/or increased flow: Boston Harbor, Upper Charles River	Increases recreational opportunities due to improved water quality and/or increased flow: Boston Harbor and Neponset, Upper Charles, Sudbury River	Increases recreational opportunities due to improved water quality and/or increased flow: Boston Harbor	Increases recreational opportunities due to improved water quality and/or increased flow: Boston Harbor, Upper Charles, Neponset, Mystic and Sudbury River	Increases recreational opportunities due to improved water quality and increased flow: Boston Harbor	same as Concept 4
	1 facility site creates a new recreation area	2 facility sites create new recreation areas 2 facility sites on Neponset River encourage access to existing recreation areas	1 facility site creates a new recreation area	2 facility sites create new recreation areas	2 facility sites create new recreation areas Increases acreage of publicly controlled land	same as Concept 4

IMPACT OF ALTERNATIVE PLANS ON SOCIAL WELL-BEING (cont.)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Adverse						
Deterioration in quality of life, health, safety		Effluent discharge may increase virus concentrations in Neponset, Middle Charles and Sudbury Rivers		Effluent discharge may increase virus concentrations in Neponset, Middle Charles, Mystic, Aberjona, and Sudbury Rivers		Effluent discharge may increase virus concentrations in Neponset, Middle Charles and Aberjona Rivers
	Effluent discharge will increase nitrate concentrations on Upper Charles River creating unpleasant conditions and hazards to water supply wells	Effluent discharge will increase nitrate concentrations in Neponset, Charles, and Sudbury Rivers creating unpleasant conditions and hazards to water supply wells		Effluent discharge will increase nitrate concentrations in Neponset, Charles, Mystic, Aberjona and Sudbury Rivers creating unpleasant conditions and and hazards to water supply wells		Effluent discharge will increase nitrate concentrations in Neponset, Charles and Aberjona Rivers creating unpleasant conditions and hazards to water supply wells

IMPACT OF ALTERNATIVE PLANS
[illegible] (cont.)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
	Longer collection systems and facilities cause greater health hazards when malfunctioning	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1
					Lagoons and application sites may breed vectors of disease and nuisances	
			Lowers flow in Charles River, causing unpleasant conditions			
						Breakdown in soils removal efficiency may contaminate water supplies and recreation areas

IMPACT OF ALTERNATIVE PLANS ON SOCIAL WELL-BEING (cont.)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Degraded Educational cultural and recreational opportunities	3 facility sites conflict with present and potential open space and recreation uses	5 facility sties conflict with present and potential open space and recreation uses		same as Concept 2	same as Concept 2	same as Concept 2
	Medway facility site restricts access to a recreation area	same as Concept 1		same as Concept 1	same as Concept 1	same as Concept 1
					Reduces recreational usefulness of state forest areas in southeastern Mass.	

IMPACT OF ALTERNATIVE PLANS ON SOCIAL WELL-BEING (cont.)

Type of Impact	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Recommended Plan
Injurious displacement of people and community disruption	Expansion of Nut Island facility may cause loss of housing	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1	same as Concept 1
	Construction may cause neighborhood disruption at 2 Harbor facility sites	same as Concept 1	same as Concept 1	Construction may cause neighborhood disruption at 2 Harbor and Woburn facility sites	same as Concept 4	same as Concept 4

APPENDICES

Appendix A

Section 201

Federal Water Pollution Control

Act Amendments of 1972

"SEC. 201. (a) It is the purpose of this title to require and to assist the development and implementation of waste treatment management plans and practices which will achieve the goals of this Act.

"(b) Waste treatment management plans and practices shall provide for the application of the best practicable waste treatment technology before any discharge into receiving waters, including reclaiming and recycling of water, and confined disposal of pollutants so they will not migrate to cause water or other environmental pollution and shall provide for consideration of advanced waste treatment techniques.

"(c) To the extent practicable, waste treatment management shall be on an areawide basis and provide control or treatment of all point and nonpoint sources of pollution, including in place or accumulated pollution sources.

"(d) The Administrator shall encourage waste treatment management which results in the construction of revenue producing facilities providing for—

"(1) the recycling of potential sewage pollutants through the production of agriculture, silviculture, or aquaculture products, or any combination thereof;

"(2) the confined and contained disposal of pollutants not recycled;

"(3) the reclamation of wastewater; and

"(4) the ultimate disposal of sludge in a manner that will not result in environmental hazards.

"(e) The Administrator shall encourage waste treatment management which results in integrating facilities for sewage treatment and recycling with facilities to treat, dispose of, or utilize other industrial and municipal wastes, including but not limited to solid waste and waste heat and thermal discharges. Such integrated facilities shall be designed and operated to produce revenues in excess of capital and operation and maintenance costs and such revenues shall be used by the designated regional management agency to aid in financing other environmental improvement programs.

"(f) The Administrator shall encourage waste treatment management which combines 'open space' and recreational considerations with such management.

"(g)(1) The Administrator is authorized to make grants to any State, municipality, or intermunicipal or interstate agency for the construction of publicly owned treatment works.

"(2) The Administrator shall not make grants from funds authorized for any fiscal year beginning after June 30, 1974, to any State, municipality, or intermunicipal or interstate agency for the erection, building, acquisition, alteration, remodeling, improvement, or extension of treatment works unless the grant applicant has satisfactorily demonstrated to the Administrator that— Conditions.

"(A) alternative waste management techniques have been studied and evaluated and the works proposed for grant assistance will provide for the application of the best practicable waste treatment technology over the life of the works consistent with the purposes of this title; and

"(B) as appropriate, the works proposed for grant assistance will take into account and allow to the extent practicable the application of technology at a later date which will provide for the reclaiming or recycling of water or otherwise eliminate the discharge of pollutants.

"(3) The Administrator shall not approve any grant after July 1, 1973, for treatment works under this section unless the applicant shows to the satisfaction of the Administrator that each sewer collection system discharging into such treatment works is not subject to excessive infiltration.

"(4) The Administrator is authorized to make grants to applicants for treatment works grants under this section for such sewer system evaluation studies as may be necessary to carry out the requirements of paragraph (3) of this subsection. Such grants shall be made in accordance with rules and regulations promulgated by the Administrator. Initial rules and regulations shall be promulgated under this paragraph not later than 120 days after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972. Rules and regulations.

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WASTEWATER ENGINEERING AND MANAGEMENT PLAN FOR BOSTON HARBOR - --ETC(U)
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Appendix B

Regional Goals and Objectives

BH-EMSA Study

Regional Selected Goals and Objectives	Derived Statement of Criteria for MDC Sewerage Plan	
	General Statement	Quantified Design Criteria for EMPIRI
I. HOUSING		
Goal A decent home and a healthy living environment for every resident of the Metropolitan Boston region.		
Sub Goals		
1. To increase the supply of housing for all individuals and families, including those of low and moderate income, in order to provide for a range of housing opportunities.	See Objectives	
2. To provide for a range of densities, housing types, and prices within sound neighborhoods and communities.		
3. To provide open residential communities receptive to all age, income, and minority groups.		

Regional Selected Goals and Objectives	Derived Statement of Criteria for MDC Sewerage Plan	
	General Statement	Quantified Design Criteria for EMPIRIC
I. HOUSING		
Objectives		
1. Promote the adoption of average residential densities on vacant land to encourage a range of housing types.	1. Public sewerage service may be necessary in all municipalities by 1990. IMPACT: Direct, Limited and/or Local, but Cumulative.	1. Quantified for EMPIRIC forecasts by setting service acreages by municipality by 10-year period. Vary by alternatives of major or minor growth.
2. Encourage replacement of substandard housing with decent housing at a cost commensurate with ability of displaced persons to pay.	2. IMPACT: Direct, Limited and/or Local.	2. Quantified for EMPIRIC forecasts by variation of density of existing development.
3. Encourage the rehabilitation of existing housing whenever possible and appropriate.	3. IMPACT: Indirect, Limited and/or Local.	3. Quantified for EMPIRIC forecasts by variation of density of existing development.
4. Encourage adequate facilities and services (educational, health, social, recreation, protection) as required to meet needs of population.	4. IMPACT: Direct, Moderate due to potential magnitude of flows generated (e.g. development or relocation of a hospital.)	

Regional Selected Goals and Objectives	Derived Statement of Criteria for MDC Sewerage Plan	
	General Statement	Quantified Design Criteria for EMPIRIC
II. ECONOMIC		
Goal		
Assurance of the economic well being of all residents by maintaining and enhancing the economic competitive position of the Metropolitan Boston Area in relation to the national economy and providing for an efficient geographic distribution of employment throughout the region.		
Objectives		
1. Provide industrial and commercial space by 1990 to aid in the expansion and modernization of those industrial and business firms already existing in the Area (especially those that indicate growth in the near future).	1. IMPACT: Direct, Moderate due to possible need for renovation or improvements in existing systems.	1. Quantified for total regional forecasts by Metcalf & Eddy. Quantified for EMPIRIC forecasts by decreasing employment density.
2a. Continue to improve and develop, where appropriate, the Region's international-domestic, general aviation, and air cargo facilities and associated terminal areas.	2a. IMPACT: Direct, Moderate due to possible need for renovation or improvements in existing systems.	

Regional Selected Goals and Objectives	Derived Statement of Criteria for MDC Sewerage Plan	
	General Statement	Quantified Design Criteria for EMPIRIC
II. ECONOMIC		
Objectives		
2b. Improve and develop the port facilities of Boston Harbor.	2b. IMPACT: Direct, moderate due to requirements for handling vessel wastewater.	
3. Maintain the Core as a center of economic activity with the objective of retaining about 35 percent of the region's total employment by 1990.	3. IMPACT: Direct, Areawide, due to possible need for significant improvement or renovation of existing MDC system, which should be oriented toward achievements of this objective.	3. Quantified as constraint on allocation. "Core" area is defined as Boston, Brookline, Cambridge, Chelsea, Everett, and Somerville.
4. Conserve and modernize, where feasible, older industrial and commercial areas throughout the Region which have good transportation access, and good market potential.	4. IMPACT: Direct, Limited and/or Local, Cumulative.	4. Quantified for total regional forecasts by Metcalf & Eddy. Quantified for EMPIRIC forecasts by decreasing employment density.
5. Adopt medium-size industrial parks or districts of 200-600 acres as basic unit of development in the new or growing portions of the Metropolitan Boston area.	5. IMPACT: Direct, Significant, Areawide.	5. Constraint on manufacturing employment allocation to areas with 200-600 acres available.

Regional Selected Goals and Objectives	Derived Statement of Criteria for MDC Sewerage Plan	
	General Statement	Quantified Design Criteria for EMPIRIC
II. ECONOMIC		
6. Encourage the further expansion of existing large regional shopping centers (500,00 sq.ft. or more) and add a variety of commercial uses (including office, governmental, institutional, and cultural uses to be integrated within).	6. IMPACT: Direct, Significant, Areawide.	6. Constraint on commercial employment to areas with sufficient vacant land for 500,000 sq.ft. centers.
7. Encourage the location of new large (500,000 sq.ft. or more) and medium-size (around 200,000 sq.ft.) retail-office centers near transit stations and near, but not at, the intersections of radial and circumferential freeways or the intersection of major arterials.	7. IMPACT: Direct, Significant, Areawide.	7. Allocation constraint to be quantified for EMPIRIC.
8. Encourage separations of local, frequent convenience-type shopping trips from regional transportation systems, through the development of local land small, retail - office centers of about 100,000 sq.ft. in residential portions of the Area near the intersections of collector or arterial transportation routes.	8. IMPACT: Limited.	8. Important for transportation forecasting; however, no specific use for purposes of MDC sewer study.

Regional Selected Goals and Objectives	Derived Statement of Criteria for MDC Sewerage Plan	
	General Statement	Quantified Design Criteria for EMPIRIC
II. ECONOMIC		
9. Encourage major new industrial development only in areas provided with public sewer facilities, except where an individual firm will be utilizing recycling water to a significant degree.	9. IMPACT: Direct, and Indirect, Significant, Areawide.	9. Sewer service areas under EMPIRIC would be established - variations would occur for alternative growth policies.
III. ENVIRONMENTAL GOALS		
Goal		
Establishment of a physical environment that is well ordered, efficient, varied as to man-made and natural features, and meets the esthetic, health, and recreation needs of all citizens.		
Objectives		
1. To enhance, protect and conserve the natural environment and the beauty of the landscape.	1. IMPACT: Direct, Significant, Areawide due to Wastewater management, Water Quality Relationships.	1. Withholding open space system acres from development.
2. To provide positive elements in the physical environment that provide for diversity and interest, as well as some sense of identity.	2. IMPACT: Direct, Local or Moderate, Related to physical design of alternative systems.	

Regional Selected Goals and Objectives	Derived Statement of Criteria for MDC Sewerage Plan	
	General Statement	Quantified Design Criteria for EMPIRIC
III. ENVIRONMENTAL GOALS		
Objectives		
3. To eliminate wherever existing, harmful and hazardous elements in the physical environment, including the reduction and elimination of stream and air pollution.	3. IMPACT: Direct, Significant, Areawide, Due to wastewater management, water quality relationships.	
4. Provide collection and treatment facilities consistent with anticipated local and metropolitan development and adequate water quality standards.	4. IMPACT: Varies from Direct but Limited to Significant and Areawide.	
5. Develop priorities for financing sewerage systems in order to most efficiently and economically meet and maintain water quality standards.	5. IMPACT: Direct, Significant, Areawide.	
6. Encourage the regional use, operation, and maintenance of facilities and service whenever feasible.	6. IMPACT: Varies.	
7. Promote cooperation among Federal, State, regional and local agencies involved in water pollution control.	7. IMPACT: Indirect.	

Regional Selected Goals and Objectives	Derived Statement of Criteria for MDC Sewerage Plan	
	General Statement	Quantified Design Criteria for EMPIRIC
III. ENVIRONMENTAL GOALS		
Objectives		
8. Provide adequate water service for Metropolitan Boston by 1990.	8. Adequate public water service would be available in all municipalities by 1990. Reuse and Recycling will be investigated. IMPACT: Limited and/or Local, Cumulative.	8. Quantified for EMPIRIC by designating water service area acreages by municipalities by 10-year period. Constrain growth in communities with existing deficiencies.
9. Provide improved wastewater service to Metropolitan Boston Area by 1990.	9. Adequate public sewer service may be necessary in all municipalities by 1990. IMPACT: Direct, Limited and/or Local, Cumulative.	9. Sewer service area acreages by municipalities by 10-year period. Constrain growth in communities with existing deficiencies.
10. Provide an open space and recreational program to include extensive land acquisition of waterfront property and islands in the Boston Harbor and other designated areas.	10. IMPACT: Direct, Significant, Areawide due to required improvements in water quality to serve recreational purposes.	10. Restricted areas would not be available to accommodate growth under EMPIRIC.
11. Reduce pollution in the Charles, Mystic, and Neponset Rivers to levels consistent with development into recreational areas.	11. Improved public sewer service and adequate treatment may be necessary in all municipalities in these basins by 1990. IMPACT: Direct, Significant, Areawide.	11. Quantified for EMPIRIC by designating sewer service area acreages by municipalities by 10-year period. Constrain growth in communities with existing deficiencies.

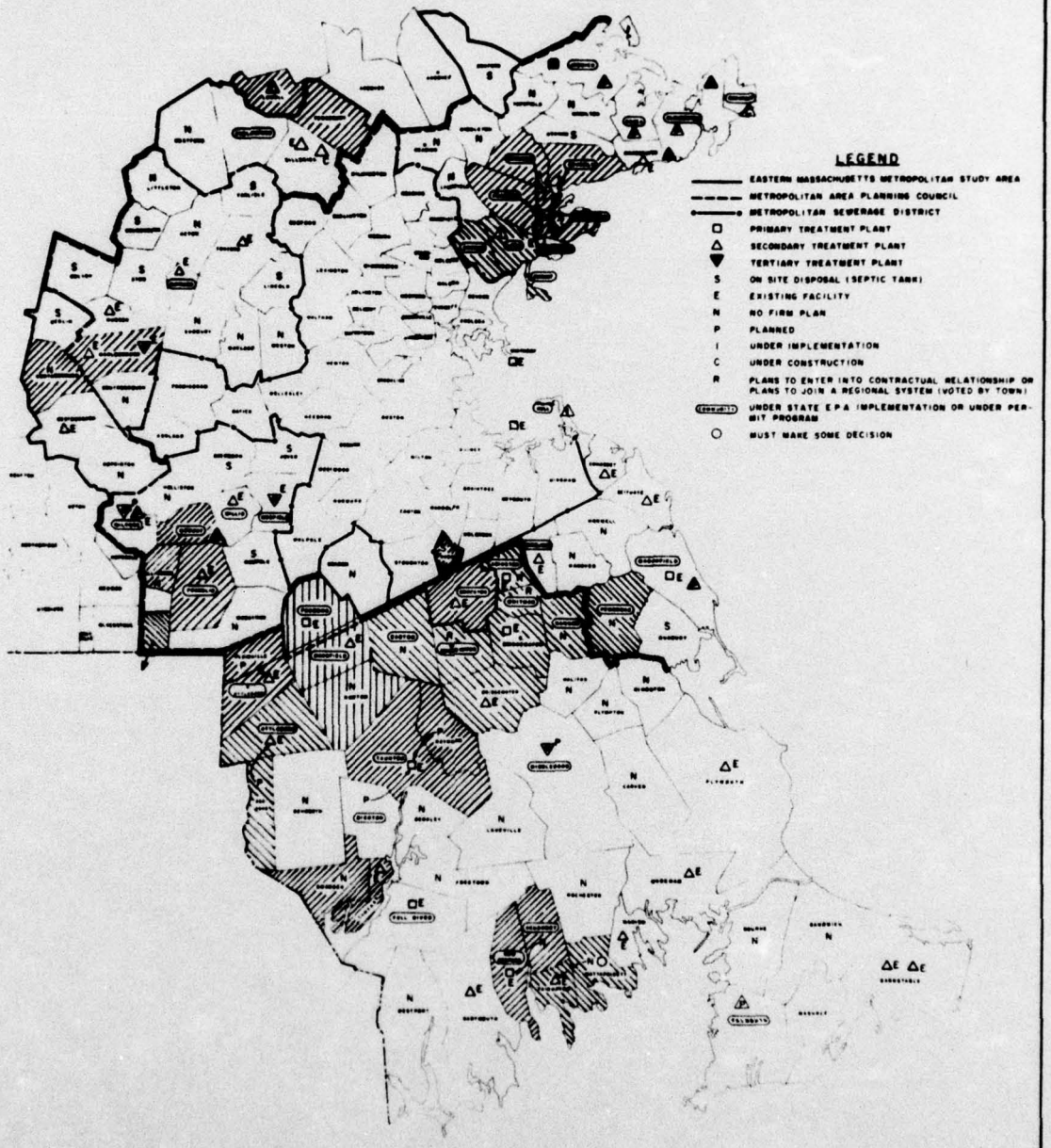
Regional Selected Goals and Objectives	Derived Statement of Criteria for MDC Sewerage Plan	
	General Statement	Quantified Design Criteria for EMPIRIC
III. ENVIRONMENTAL GOALS		
Policies		
1. Sewage facilities shall be constructed so that waters will be retained, whenever possible, in the drainage basin of original use.	1. IMPACT: Direct, Moderate, may require recycling or reuse.	
2. Separate systems for collection, conveyance and treatment of storm-waters and sewage shall be required for all new construction and for the extension of all existing systems.	2. IMPACT: Direct, Significant, Areawide due to need for storm-water treatment.	
3. Encourage local adoption of a sewer use ordinance consistent with community objectives, water quality standards, and economical waste-water treatment.	3. IMPACT: Direct, Limited and/or Local, Cumulative.	
4. Encourage member communities to maintain an up-to-date sanitary sewerage master plan commensurate with the growth and future needs of the community.	4. IMPACT: Direct, Limited and/or Local, Cumulative.	

Regional Selected Goals and Objectives	Derived Statement of Criteria for MDC Sewerage Plan	
	General Statement	Quantified Design Criteria for EMPIRIC
III. ENVIRONMENTAL GOALS		
Policies		
5. Encourage the establishment of programs of phased construction which will permit economical utilization of advanced designs and maintain the treatment requirements imposed by State and Federal agencies, relative to degree of treatment and nutrient removal.	5. IMPACT: Direct, Moderate, Cumulative.	

Regional Selected Goals and Objectives	Derived Statement of Criteria for MDC Sewerage Plan	
	General Statement	Quantified Design Criteria for EMPIRIC
IV. TRANSPORTATION GOALS		
Goal		
Provide for the safe, convenient travel of the general public by menas of integrated, intermodal transportation systems.		
Objectives		
1. Transportation requirements over the next 20 years within Route 128 will be met with improved and expanded public transportation systems, expecially mass transportation.	1. IMPACT: Indirect, Moderate.	1. No significant increase in highways until after 1990. Meet the Core area transportation requirements through modernization and expansion of public mass transportation.
2. To provide multiple modes of transport which support other objectives of the area.	2. IMPACT: Indirect, Moderate.	

Appendix C

Existing and State-EPA Proposed Treatment Facilities in the BH-EMMA Study Area



NOTE

THE SHADED AREAS REPRESENT THE VIEWS OF THE MASSACHUSETTS DIVISION OF WATER POLLUTION CONTROL INSOFAR AS REGIONALIZATION OF WASTEWATER TREATMENT IS CONCERNED. THESE VIEWS ARE IN PROCESS OF EVOLUTION BUT ARE CORRECT TO THIS DATE 7/2/74

Revised 7/16/75

BOSTON HARBOR

WASTEWATER MANAGEMENT STUDY

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION - CORPS OF ENGINEERS

WALTHAM, MASS

Appendix D

Preliminary Impact Assessment

Information Packet

for

Mid-stage Public Meetings

May 1974

Preliminary Impact Assessment

The river basins and water bodies of the 109-community metropolitan area have been used to delineate geographical areas for impact assessment. The preliminary assessments on the following pages deal with impacts that might be expected with the implementation of each of the five regional wastewater management concepts.

Aquatic environment, hygienic considerations and socio-economic conditions have been the areas chosen for analysis and evaluation. There are two separate presentations: the first is for the aquatic environment and hygienic considerations and the second for socio-economic conditions.

Impacts on Aquatic Environment and Hygienic Considerations

In assessing impacts on the aquatic environment, emphasis was given to: (1) how the anticipated volumes of renovated wastewater would affect river flows, especially the sluggish flows that accompany dry seasons; (2) how different concentrations of pollutants that remain in wastewater after treatment would affect plant and animal life; and (3) maintaining a hydrological balance or whether municipal water supplies would still originate and remain within the watershed undergoing assessment.

For scrutinizing hygienic impacts, attention focused on (1) bathing beaches; (2) shellfish harvest areas; and (3) water supplies.

Concept One

Impacts on Aquatic Environment

Assabet River - Two advanced waste treatment plants are proposed along this stream. One would be at Hudson and the second, a larger plant, would be upstream at Marlboro (westerly). The Marlboro plant would add substantial amounts of water to the river. This water would be vital in maintaining flow in the river during periods of low flow.

Previously established littoral (shore) zones would be substantially reduced and portions of the river bank that had been dry during low flow periods might be continually flooded. Vascular plants, such as pond weeds and various reeds, might crop up to take advantage not only of the new water levels but also the rich source of nutrients, although the nutrient levels depend on the degree of nutrient removal during wastewater treatment.

Initial discharges of ammonia at the treatment plants may prove toxic to some sensitive organisms, especially with pH values above 7.0. Small excesses of chlorine too, in the effluent from treatment plant may be toxic. They would appear as free chlorine and chloramines. Changing over from a plant in Hudson to a plant in Stow will not alter this situation.

Sudbury River - Wastewater from this watershed will be discharged to Boston Harbor after treatment at Nut Island. The impacts of this concept, then, are believed neutral.

A treatment plant at Sudbury will have much the same kind of biological and hydrological impacts on the river as the plant in Marlboro but they will be on a smaller scale in line with the small size of the Sudbury plant.

Concord River - Construction of a treatment plant and an intercepting sewer system should cause a significant environmental improvement in polluted Nagog Brook. The impact of the large treatment plant will be similar to that of the Marlboro plant on the Assabet River. Again, ammonia from the plant may produce localized toxic effects.

Ipswich River - Recent Division of Water Pollution Control reports indicate a decline in water quality that is probably due to rapid population growth in the North Shore area, and the common use of household septic systems. Continued population growth may offset any improvement in river quality created by the regional plans.

Few impacts are expected on hydrological conditions and biological impacts would be similar to those for the Assabet River; that is, plant growth in response to nutrients and localized toxicity to ammonia at alkaline pH values. Chlorinated effluent may be a problem around the estuary since marine organisms are sensitive to free chlorine and chloramines.

Mystic River - No changes are indicated.

Charles River - Proposed treatment plants at Milford, Medway and Medfield should have a positive overall impact since they are to replace plants that discharge a poorer quality effluent into the river. By the year 2050, however, considerable amounts of water will have to be imported into the watershed to supply municipalities, and the environmental consequences of discharging effluent from plants at Milford, Medway and Medfield will increase. The negative impacts probably won't be important; increased plant growth and localized toxicity to ammonia and chlorine can be expected.

Neponset River - Only one change from the current situation is indicated. Installing sewers in the Town of Sharon will tend to remove a small amount of water from the watershed.

North River - Upgrading the treatment plant at Rockland should improve local water quality. The small volume of effluent is expected to have a neutral impact on river flow.

Ocean Discharges - The plan to discontinue dumping of sludge from Deer and Nut Island treatment plants should yield a substantial and positive environmental impact. The proposed shift from a primary to a

secondary treatment level should by itself have a neutral or minimal positive effect. In treatment plants that now discharge raw sewage, a higher level of treatment is recommended, primarily to remove settleable solids. Care should be taken in all plants to ensure that discharged effluents contain essentially no concentrations of residual chlorine.

Hygienic Considerations

Coastal Areas

Boston Harbor

Boston Harbor is presently polluted by wastes emanating from many sources. The major sources of pollution are: (1) wastewater effluents from Deer and Nut Island sewage treatment plants; (2) sludge from Deer and Nut Islands; (3) combined sewer overflows; (4) raw sewage outlets; (5) oil spillage; (6) refuse and debris; (7) wastes from ships; (8) waste from industry; and (9) polluted tributary streams.

All of these sources of pollution contribute to hazardous hygienic conditions in recreational areas. Bathing at some beaches is restricted. All shellfish harvesting areas are closed to the general public, and an increasing number are closed to commercial harvesters who are required to send shellfish to a depuration plant.

The change in water quality resulting from a shift from primary to secondary treatment may be negligible. However, the discontinuance of ocean discharge of sludge should improve water quality and thus have a positive hygienic impact.

Whether these changes in water quality will significantly lessen the threat to public health at bathing and shellfish areas depends on the importance of other polluting sources listed above. Further study is needed on the relative importance of all pollutants in different areas of the harbor.

South Coastal - North River Basin

The south coastal area has fewer pollution problems than Boston Harbor, although water quality in Scituate and Cohasset Harbors is below its designated A classification. Sanitary conditions at bathing beaches and shellfish areas are threatened by pollution resulting from inadequately treated municipal wastewater, runoff, pesticides use in cranberry bogs, and, to a lesser extent, wastes from ships. The North River is one of the cleanest rivers in Massachusetts, although many of its feeder streams are polluted by subsurface disposal and small industries.

No change in treatment is proposed for the Towns of Scituate and Cohasset. However, extension of collection systems will result in higher flows, and a greater effluent discharge, which may have a small negative impact on recreational areas. However, this may be compensated by a positive impact to the North River Basin, as addition of collection systems to the Towns of Hanover, Pembroke and Norwell will eliminate the threat of contamination due to inadequate subsurface disposal to streams in the area.

This shift from discharge of raw effluents to secondary treatment in Hull will improve water quality and produce a positive impact on the public health in bathing and shellfish harvesting areas. Extension of the collection system will also have a positive impact due to the fact that soil conditions in this town are unsuitable for subsurface disposal.

The shift from primary to secondary treatment in Marshfield will probably produce a negligible change in water quality and have a negligible effect on public health. Extension of the collection system will have a positive hygienic impact through elimination of the threat of contamination from subsurface disposal in the area. The larger flow at Marshfield may present a greater hazard in the event of operational failures.

North Coastal - Ipswich River

In the North Coastal area, shellfish harvesting and bathing is restricted in some areas, and drinking water supplies are threatened due to pollution from inadequately treated municipal sewage, faulty subsurface disposal systems, combined sewers, and landfill leachates. The Ipswich River is also polluted from inadequate subsurface disposal systems, and leachates from landfills.

Presently, the quality of water in Rockport Harbor is low due to untreated municipal waste and faulty subsurface disposal. The shift from ocean discharge of raw wastes to secondary treatment will improve water quality and have a positive hygienic impact as the threat of contamination to recreational areas is decreased. Extension of the collection system will also have a positive impact on the water quality of coastal waters due to elimination of faulty subsurface disposal.

Gloucester Harbor is closed to bathing and shellfish harvesting because of pollution resulting from raw sewage discharge, poor subsurface disposal, and combined sewers. The shift from discharge of raw wastes to secondary treatment plants will have a positive hygienic impact in this area, however, pollution from combined sewers must also be considered. Extension of the collection system especially to the Lanesville area of Gloucester will have a positive impact through elimination of malfunctioning subsurface disposal system.

The Harbors of Beverly, Salem, Marblehead and Lynn, Nahant Bay and Broad Sound are presently polluted by discharge of raw municipal wastes. Combined sewers also add to the pollution problem in Lynn Harbor, and urban runoff is a problem in the more densely populated areas near Boston. The shift from discharge of raw wastes by the South Essex Sewage District (SESD) and the Towns of Lynn, Nahant, Saugus, and Marblehead, to two regional secondary treatment plants (one serving the SESD and Marblehead, and one serving Lynn, Nahant and Saugus) will improve water quality of the coastal areas, and have a positive hygienic impact on bathing beaches, and on shellfish areas which are presently closed to harvesting. Combined sewer overflows and urban runoff will not be affected, but must be considered in the total hygienic assessment. There will be no change in the threat of treatment plant failures, since a large part of these areas are served already, and there will be a negligible change in flow. The coastal area of Swampscott is also highly polluted from the raw sewage discharge of this town. The shift to secondary treatment will improve water quality and have a positive hygienic impact.

There will be no change in plans for the Town of Manchester.

The Essex River is closed to shellfish harvesting in the downtown Essex area due to subsurface disposal problems. The shift from subsurface disposal to secondary treatment in Essex will improve water quality causing a positive hygienic impact on shellfish areas. The threat of operational failure of the treatment plant may cause a greater hazard than faulty subsurface disposal systems.

In the Ipswich River Basin, the Towns of Middleton, North Reading, Hamilton and Topsfield are presently served by subsurface disposal systems. These systems are malfunctioning in the Towns of Middleton and North Reading, presenting a threat to the public health in bathing areas on the Ipswich River. The shift to a regional advanced waste treatment plant in Middleton will improve water quality and have a positive impact. The Towns of Hamilton and Topsfield presently have no subsurface disposal problems. The shift to advanced waste treatment at Hamilton may have a possible negative impact due to localized discharge of effluents. However, with the rapid development of these areas, subsurface disposal pollution may become a problem, and construction of an advanced waste treatment plant may have a final positive hygienic impact. Again, large regional plants will present a greater hazard in case of operational failures.

Presently, shellfish harvesting areas are closed in the tidal portion of the Ipswich River and the quality of bathing water is threatened. The shift from primary to secondary treatment at Ipswich may cause a negligible change in water quality. However, extension of the collection system in Ipswich will improve water quality as parts of the town are presently served by malfunctioning subsurface disposal systems. Water quality will also be improved by the upstream advanced

treatment plants. The total change in water quality may greatly improve sanitary conditions and have a substantial positive impact.

Inland Streams

Charles River - The upper Charles River is polluted by overloaded sewage treatment facilities, inadequate subsurface disposal systems, leachates from dumps, and industrial discharges, while the lower Charles is polluted mainly by industry, combined sewer overflows and urban runoff. The pollution of the Charles from these sources presents a threat to the public health at recreational areas. Presently, the Towns of Franklin, Medfield, Medway and Millis provide secondary treatment to a portion of their town's wastes. Under this concept, the advanced waste treatment plants in Medway, Medfield and Milford will probably improve the quality of water and have a positive hygienic impact. A small negative impact may result from the greater threat in case of treatment plant failure and increased flow of effluents in more localized areas. Pollution from other sources must be considered to determine the net impact.

The lower Charles River would be unchanged by this concept.

Mystic River - This concept would not change the current situation in this river basin.

Neponset River - This concept would not change the current situation in this river basin.

The SUASCO - The Sudbury, Assabet and Concord Rivers are polluted mainly by effluents from malfunctioning municipal treatment plants, and inadequate subsurface disposal systems. Both bathing areas and drinking water supplies are threatened by pollution from these sources.

In the Assabet River Basin, this concept calls for a shift from the secondary treatment plant in Hudson to an advanced treatment at another location in Stow, and the establishment of a regional advanced waste treatment plant in the western part of Marlborough. The shift to advanced waste treatment at Marlborough westerly will have a positive hygienic impact as it will replace an existing faulty treatment plant in Westborough. The Marlborough westerly plant will also augment the Assabet during low flow, thus diluting the river's pollutants. There will be some negative impact from the large quantity of effluent in the event of treatment plant failure. The shift to advanced treatment at Stow will probably have a negligible effect.

In the Concord River Basin, the shift to advanced waste treatment at Concord will probably have a positive hygienic impact as it would probably improve water quality. The extension of collection systems, especially to towns with failing subsurface disposal systems in the year 2000, will improve the quality of water in recreational areas and drinking water supplies in the Concord River Basin.

This concept calls for a regional advanced waste treatment plant in Sudbury. Presently, the Towns of Sudbury and Wayland are served by individual subsurface disposal system. The establishment of this advanced plant will have a positive effect on the public health if addition of a collection system and waste treatment plant will improve water quality over present conditions. Another thing that must be considered is the fact that the projected rapid increase in population of these towns within the next 20 to 30 years may cause development of areas unsuited for subsurface disposal, and thus cause the need for municipal treatment to protect the public health. Finally, the threat produced by an operational failure at a large regional plant must be taken into account.

Concept Two

Aquatic Environment

Assabet River - Same as Concept 1.

Sudbury River - Impacts of a treatment plant to be built at Framingham would be similar to the impacts described for the Assabet River; however, because the Framingham plant would be so large (in terms of discharge), its dominance of the river system will be even greater. Otherwise the impacts are the same as Concept 1.

Concord River - Same as Concept 1.

Ipswich River - Same as Concept 1.

Mystic River - Same as Concept 1.

Charles River - The upper basin will be the same as described in Concept 1.

Some negative environmental impact may be expected from the discharge of sizeable treatment plant at Dedham. If however, the treatment includes a high degree of nutrient removal, the considerable augmentation of river flow by cleaner water could become a positive benefit of this plant.

The treatment plant proposed for Watertown should be built below Watertown Dam. High treatment levels would be required since the effluent would be flowing into what is essentially a lake and is no longer a stream.

Neponset River - The installation of two treatment plants, with the upstream plant discharging a greater quantity of wastewater, would, from a hydrological standpoint, provide flow augmentation that should be beneficial to this stream, considering its present diminutive upstream flow. Biologically there should be some slight positive impact.

North River - Same as Concept 1.

Ocean Discharges - Same as Concept 1.

Hygienic Considerations

Coastal Areas

Essentially the same as Concept 1.

Inland Streams

Charles River - The upper Charles Basin would have the same impacts as Concept 1. This Concept proposes regional advanced waste treatment plants at Watertown and Dedham. Discharges of effluents at these locations may have a negative effect on the water quality, however, this may also depend on the assimilative capacity of the stream. Negative impacts may also result in the event of treatment plant failures. Again other sources of pollution must be considered.

Mystic River - Same as Concept 1.

Neponset River - The lower portion of the Neponset River is presently polluted by urban runoff and the combined sewers of Boston. Industrial discharges have severely degraded the quality of the water in years past, although all industries are presently being connected to the Metropolitan Sewage District. Concept 2 proposes two advanced waste treatment plants with the upstream plant discharging the large quantity. There may be a slight negative change in the water quality downstream depending on the ability of the river to assimilate added wastes. The treatment plant upstream may cause an improvement in water quality and a positive impact on sanitary conditions due to augmentation of low flow and the dilution of any polluting substances.

The SUASCO - The impact on this river basin will be the same as Concept 1 with the exception of the advanced waste treatment plant in Framingham. Such a large treatment facility may have some negative public health impact due to localized discharge of large quantities of effluent, and the increased hazard in the event of treatment plant failure.

Concept 3

Aquatic Environment

Assabet River - Same as Concept 1.

Sudbury River - Same as Concept 1.

Concord River - Same as Concept 1.

Ipswich River - Same as Concept 1.

Mystic River - Same as Concept 1.

Charles River - Discharging all of the wastewater from the Charles River Watershed to Nut Island would cause a substantial reduction in river flow, accompanied by a reduction in suitable habitat for aquatic life.

Neponset River - Same as Concept 1.

North River - Same as Concept 1.

Ocean Discharges - Same as Concept 1.

Hygienic Considerations

Coastal Areas

Essentially the same as Concept 1.

Inland Streams

Charles River - Concept 3, which proposes discharging all of the wastewater from the Charles River Basin to Nut Island would have a negative impact on water quality and sanitary conditions of the Upper Charles River Basin Area. The rest of the Charles River Basin will have the same impact as Concept 1.

Mystic River - Same as Concept 1.

Neponset River - Same as Concept 1.

The SUASCO - Same as Concept 1.

Concept 4

Aquatic Environment

Assabet River - Same as Concept 1.

Sudbury River - Same as Concept 2.

Concord River - Same as Concept 1.

Ipswich River - Same as Concept 1.

Mystic River - The installation of a large treatment plant at Woburn would probably benefit the polluted Aberjona River, with respect to water quality. For example, ammonia levels on this major tributary

are so high that projected ammonia concentrations in the effluent will represent a dilution. Biological productivity may increase on the river, but the aquatic life present will be of marginal value to mankind. Factors (i.e. illicit discharges) not considered by the wastewater management alternates, as presently constituted, will probably continue to control the environmental destiny of the Mystic River watershed.

Charles River - Same as Concept 2.

Neponset River - Concept 4 combines the two treatment plants of Concept 2 into one. From an environmental standpoint, local impacts such as toxicity and eutrophication would probably be unduly accentuated by this plan. Both biologically and hydrologically Concept 4 would be less desirable than Concept 2.

North River - Same as Concept 1.

Ocean Discharges - Same as Concept 1.

Hygienic Considerations

Coastal Areas

Same as Concept 1.

Inland Stream

Charles River - Same as Concept 2.

Mystic River - For this river basin, the concept provides a change in the present status. The Aberjona River, which flows into the Mystic is presently polluted by industrial wastes, debris and runoff. It is also plagued by a serious low flow problem in summer months. The bathing areas on the Mystic Lakes are threatened by pollution from the Aberjona. The Mystic River is highly polluted from storm drain and combined sewer overflows, oil spills and wastes from ships. These conditions have greatly degraded areas that could be used for recreation. The proposed advanced waste treatment plant at Woburn would probably improve water quality and have positive impact on the Aberjona by augmenting flow and diluting pollutants. The location of an advanced waste treatment plant in Medford will probably cause negligible changes to water quality on the Mystic due to large quantities of pollutants from the other sources mentioned.

The threat of operational failure to the public health is greatest in this concept.

Neponset River - Concept 4 proposes one large advanced treatment plant in Canton. This concept may be less desirable than Concept 2 due to the larger discharge of effluents at one point. Again the assimilative capacity of the river must be considered.

The SUASCO - Same as Concept 2.

Concept Five

Impacts on Aquatic Environment

Assabet River - Same as Concept 1.

Sudbury River - As in Concept 1, water will be diverted from the southern portion of the basin which will have essentially neutral impacts.

The transmission of secondary effluent from the treatment plants in Sudbury and Concord to the land application site further north will tend to reduce the flows in the Sudbury River and consequently reduce the suitable habitat for aquatic life.

Concord River - The addition of highly treated effluent through the groundwater from the land treatment site should be beneficial to the Concord River.

Ipswich River - Same as Concept 1.

Mystic River - Same as Concept 1.

Charles River - The land treatment systems in the upper basin should have a net positive impact on the river due to the addition of the highly treated effluents to the base flow in the summer months.

Neponset River - The addition of highly treated effluent from the land treatment sites in the upper part of the watershed during the summer months should provide positive benefits to the Neponset River.

North River - Same as Concept 1.

Ocean Discharges - Same as Concept 1.

Water Courses Outside the Study Area - The return flows from the land application sites should provide benefits to the streams through increase of low flows. This additional water would be available for most desired uses.

Terrestrial Impacts - The land treatment sites will remain as open space. Production of vegetation on the spray irrigation sites will be increased. The sites could be converted from forest to cropland. The installation of the rapid infiltration sites will cause considerable disruption of the present vegetation. After installation, the area will be characterized by a series of wet and dry ponds with grass vegetation.

Hygienic Considerations

Coastal Areas - Same as Concept 1.

Inland Streams - Within the rivers the hygienic impacts will be essentially the same as Concept 1.

Land Application Systems - In assessing the hygienic impacts of a land application system, the following factors must be considered:

1. The efficiency of the total system in the removal of pathogens and harmful chemicals which could potentially contaminate both ground and surface waters.

2. The threat of contamination of rock and vegetation by residual pathogens and chemicals.

3. The effectiveness of controls to prevent contamination of water supplies, recreation areas, vegetation and air surrounding the application site.

All of these factors are accounted for in a property designed and managed land application system.

Impacts on Socio-Economic Conditions

Until the four concepts are further developed, it will not be possible to weigh the activities or objectives created by the concepts that are sometimes called plan actions against the social and economic conditions in which they are reflected and which are known as impact categories. A sample of the chart used for this measurement is on Figure 6.

It is possible to characterize anticipated impacts by examining the concepts in the light of past experience, and such a discussion follows.

Population

The concepts were developed to serve the population projected for these areas in the state and regional planning process. Therefore, they are not expected to bring about a radical, unanticipated change in population-size. The primary impacts on population will be to influence both the location of residential development and the relative rates of development within the area. The residential pattern will follow the location of interceptors. In the case of the centralized concepts, this implies that there will be more pressure for residential development (and thus concentration of population) in the central portion of the study area than that of the fringe of the area. Although population growth will still occur in the outlying areas, it will be slower under the centralized concepts than under the decentralized ones.

Agriculture

Agriculture is not a significant portion of the economy in this region. Although the trend in farming practices is toward larger-size operations and fewer farmers in New England, farms still remain small compared to those in other parts of the nation. Due to the limited size of agricultural operations and practices, it is believed that either secondary or advanced wastewater treatment will have very little direct impact on existing conditions. However, rising property tax rates and increased property values stimulated by development pressures may lead to a decrease in the size and number of farms. Since most of the farms are in the outlying areas, these pressures would be strongest under the decentralized concepts.

Commercial Fisheries

Important commercial fishing activities include the harvesting of soft-shell clams and lobsters and fishing for winter flounder and cod in Boston Harbor. At the present time, most of the soft-shell clam flats are classified by the State Board of Health as contaminated, primarily due to sewage wastes in harbor waters. None of the flats are

FIGURE 6

ROWS: PLAN ACTIONS		COLUMNS: IMPACT CATEGORIES	1 Agriculture	2. Manufacturing	3 Service Sector	4 Employment	5 Personal Income & Wealth	6 Housing	7 Recreation	8 Transportation	9 Land Use	10 Municipal Services	11 Municipal Finance	12 Community Growth & Development	13 Health & Security	14 Amenities
OBJECTIVES	A	Water Quality														
BY-PRODUCTS	B	Water Supply														
	C	Collection System														
	D	Treatment Products														
SHORT-TERM REQUIREMENTS	E	Construction														
LONG-TERM REQUIREMENTS	F	Land Modification														
	G	Capital Cost Funding														
	H	Private Abatement Actions														
	I	Operations														

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open to unrestricted digging and harvested clams must be treated before they can be sold. Water pollution also has a mortal effect on the other aquatic life in the area. It is anticipated that any of the wastewater management concepts will enable greater utilization of these valuable resources by both increasing the population and number of species of resident fish and reducing the processing cost of seafood.

Manufacturing

Manufacturing impacts can be expected to be very limited if regulations are enacted on a nation-wide basis. If all firms in an industry are simultaneously affected by roughly similar cost factors, particularly if these costs are a relatively small proportion of total production cost, competitive positions of individual firms will be little changed.

However, there are two situations in which industries could be affected by the proposed plans. First, costs of compliance for a particular firm might be so much higher than the average for the industry that the firm's competitive position would be worsened. Second, a firm's current operating position might be so weak that it could not bear the initial changeover costs, even knowning that such costs could ultimately be passed on. The first situation would certainly lead to a loss in profits, and quite likely to a major cutback or closing. The second situation would probably lead to plant closing. This impact would be felt most strongly in areas with existing industry. Generally, this will not differ among the concepts since costs of compliance should be about the same regardless of the concept employed.

Service Sector

Changes in residential, manufacturing, and recreation activity will be reflected in an increased demand for retail, real estate, repair, restaurant and other service activities. In areas where development and growth are stimulated, the service sector will benefit; and where other activities are diminished, this sector will also decline.

Employment

Increased employment may result in the short-term from construction and in the long-term from increased manufacturing expansion and multiplier effects of general development impacts. Reduced employment will occur if marginal plants are forced to shut down. These effects will probably follow the development pattern stimulated by the wastewater management concepts.

Personal Income and Wealth

The personal income and wealth of a community will be affected most directly by changes in property values, tax rates and user charges. Changes in property values can be attributed to four kinds of project impacts:

(1) Increases in the quality of the environment near the improved water body attract improved facilities and services.

(2) Areas become more attractive for development because of availability of services.

(3) The plan requires the removal of existing housing and other facilities; the price for those remaining increases because of the reduction in supply.

(4) Residences are changed in order to be near the water; the increases in waterfront property prices can be expected to be offset by decreases in prices at former residence sites.

Impacts on employment and the service sector will also be important in determining the shifts in personal income and wealth. These effects will be felt in varying degrees in all parts of the study area.

Housing

This category refers to destruction of housing and need for relocation housing due to wastewater management activities. (Unanticipated need for residential land will be dealt with in the analysis of impacts on Land Use). The areas that will be affected will depend on the sites chosen for facilities.

Recreation

Increased recreational opportunities and their secondary economic impacts on the service sector associated with recreation and tourism are expected to figure among the most notable benefits of implementing advanced wastewater treatment systems in the Eastern Massachusetts Metropolitan Area. Changes in water quality will increase the water-based and water-related activities on the rivers and harbor shore line. These include:

Water-based Activities:

1. Swimming
2. Water Skiing
3. Power Boating
4. Nonpower Boating
5. Game Fishing
6. General Fishing

Water-related Activities:

1. Picnicking
2. Hiking
3. Bicycling
4. Camping
5. Sightseeing
6. Horseback riding

Development of recreation facilities will probably occur increasing recreation accessibility.

Transportation

Wastewater management activities do not usually have a direct long-term impact on transportation. An indirect impact might occur if population and economic growth is concentrated around the core of the area. This would make mass transportation more economical and efficient. The most direct impact would probably be the short-term impact of construction of interceptors and force mains since these follow and/or cross roads in many towns. There will be virtually no disruption of traffic on Interstate or State Highways since tunneling is required. In other areas, construction will be present for up to 1 year. This may create some tie-ups at peak travel times but disruptions can be minimized through proper traffic control. It is possible that these disruptions will have an economic impact if construction takes place in a commercial area. This impact will not vary much.

Land Use

A major form of broad-scale environmental impact that often results from wastewater treatment activities is changes in land use. Plan actions that will induce long-term changes are collection system and land modification.

The collection system may stimulate growth in areas where development was not planned. This results from the provision of basic services needed to support growth. Once such services are provided to an area, additional growth will occur to take advantage of these services. Conversely, the system may constrain planned development by not providing services to areas where growth was to be encouraged. Land modification refers to land use change resulting either from construction of treatment facilities or designation of land areas for land application sites. In the first case, land use changes might occur because of incompatibility between a new use (e.g., treatment plant) and existing adjacent uses (e.g., residential). Finally, land use changes will occur where large amounts of land are required for land application in Concept 5 and may be shifted from one land use category to another.

Again the more centralized concepts will tend to encourage more intensive land use of all types around the core area. Development in other areas will not be stopped but will occur more gradually.

Municipal Services

Development of new areas will result in increased needs for school, sanitation services, police and fire protection and other municipal services. Those communities where the most development will occur will have to respond to these increased demands.

Municipal Finance

If property values are reassessed to correspond to increased economic use of the land, higher municipal revenues can be expected. However, new or more intensive activities will require additional expenditures for expanded municipal services. The net result can be negative, particularly if additional demands are made for municipal services.

Appendix E

The Potential Effects of Wastewater Treatment Alternatives on the Flow of the Concord River below River Meadow Brook at Lowell

The Potential Effects of Wastewater Treatment Alternatives on the Flow of the Concord River below River Meadow Brook at Lowell,

Planning for wastewater treatment in the Sudbury-Assabet-Concord (SUASCO) River basin includes alternatives for intra-basin treatment and discharge, out of basin transfer by sewerage and additional recharge to the basin from extra basin sources. Concern has been expressed about the effect of wastewater diversion on the stream flow duration of the SUASCO River basin particularly the Sudbury River. If future net water withdrawals from the basin exceed the present rate, then the flows of the river will be diminished. Such a reduction of flow could cause problems of both aesthetic and hygienic nature, and these might become serious especially in times of low flow. In order to more fully assess the problem, a study of flow duration in the basin was performed. This study is similar to and was modeled upon Frimpter's 1973 USGS open file report, "Groundwater Management Charles River Basin, Massachusetts." This analysis is concerned only with factors contributing to low flow characteristics of the Concord River. It does not address high flow characteristics or their impact on the river system.

There are four stream gage stations in the SUASCO River Basin. These are Bolder Brook at East Bolton, Nashoba Brook near Acton, the Assabet River at Maynard and the Concord River below River Meadow Brook in Lowell, MA. The USGS publishes monthly field data computed and supplied by the MDC for the basin upstream from Framingham Reservoir No. 1. These data are published as Sudbury River at Framingham Center, but are not a product of a gaging operation. The gage in the Concord River was selected for this analysis because it alone includes the flow of the basin as a whole. The reported Sudbury records reflect only the operation of the MDC reservoir. The Assabet gage does not measure hydrologic information in the Framingham-Ashland area with which we are concerned. The gages at East Bolton and Acton are of tributaries of the Assabet River. The Sudbury River comprises only about 40 per cent of the drainage area of the Concord River gage and thus the Concord gage does not accurately reflect the Sudbury River.

The Concord River gage has a drainage area of 405 square miles which includes part or all of 24 communities. Figure 1 is the flow duration curve for the Concord River below River Meadow Brook in the City of Lowell, MA for the period of record 1936-1970.

Table 1 lists the 24 communities under consideration along with the following information:

a. Estimated 1970 average daily water demand or safe yield - (mgd)
b. Estimated 2000 average daily water demand - (mgd)
c. Increase in average daily water demand 1970 to 2000 - (mgd)
d. Increase in average daily water demand 1970 to 2000 - (cfs)
e. 1970 source of water supply (in or out of basin) - ref "Projected Needs and Current Proposals for Water and Sewer Facilities" MAPC
f. Most likely source of future water supply (in or out of basin) - ref "Alternative Regional Water Supply Systems for the Boston Metropolitan Area" - MAPC News Staff
g. Most likely sewer discharge point (in or out of basin) in 2000
h. Estimated 2000 sewerage discharge out of basin in excess of 1970 - (mgd)

From 1970 to 2000, the average daily water demand over present use or safe yield will increase 57 cfs in the 24 communities. If it is assumed that all increased demands are met from groundwater within the basin, that no additional water is imported into the basin and that all of this increased demand is sewered out of the basin, then there is a good probability that the flow of the Concord at Lowell would approach zero approximately 5.5 per cent of the time of 20 days out of the year in 2000. This conclusion is based upon the fact that in 1970, according to the flow duration curve in Figure 1, the flow was equal to or less than 57 cfs for 5.5 per cent of the time. If we consider that the maximum monthly demand is 1.2 times the average and that occurs during low flow period, then the flow of the Concord during an average year would approach zero for approximately 31 days.

These projections, however, are unrealistically extreme because the assumption that no additional water will be imported to the basin is incorrect. Study of future water supply plans for the communities in the basin show that while some towns will, in fact, derive their water from within the basin and sewer it out of the basin, these constitute the exception rather than the rule. Table 1 lists figures for present and projected transfer rates of water in and out of the basin by community.

Of the twenty-four communities listed in Table 1, fifteen of them will either meet their future demands from within the basin and sewer that back to the basin or will import their water from outside the basin. Since these towns are neither exporting nor importing any net

quantity of water, they have no effect on the overall projected change in water balance of the basin and thus can effectively be ignored in this kind of flow regiment forecast. The remaining nine communities have future plans which will result in a net transfer of water either in or out of the basin.

In this projection for the year 2000, three towns will draw water from the basin and sewer it out. Ashland, Hopkinton, and Natick will transfer out of the basin amounts of 1.33 mgd, 1.64 mgd, and 1.99 mgd respectively above that currently being sewered out, giving a total increased export of water in 2000 of 4.96 mgd or 7.67 cfs. Six towns by 2000 will be importing water to the basin in order to meet needs in excess of current supply or safe yield and will be sewering this excess into the basin. The Towns of Acton (2.06 mgd), Concord (.07 mgd), Littleton (.69 mgd), Marlborough (one-half of the community - 2.71 mgd), Maynard (1.75 mgd), and Shrewsbury (1.83 mgd) will collectively transfer 9.11 mgd or 14.1 cfs into the basin.

In summary, plans for water use and supply for the year 2000 call for fifteen towns to have no net import or export of water, three towns to export a total of 4.96 mgd or 7.67 cfs, and six towns to import a total of 9.11 mgd or 14.1 cfs. The result of these transfers is a net import of 4.15 mgd or 6.42 cfs. Based upon these projections, it can be predicted that in 2000, the flow of the Concord River will, on the average, be slightly higher than at present.

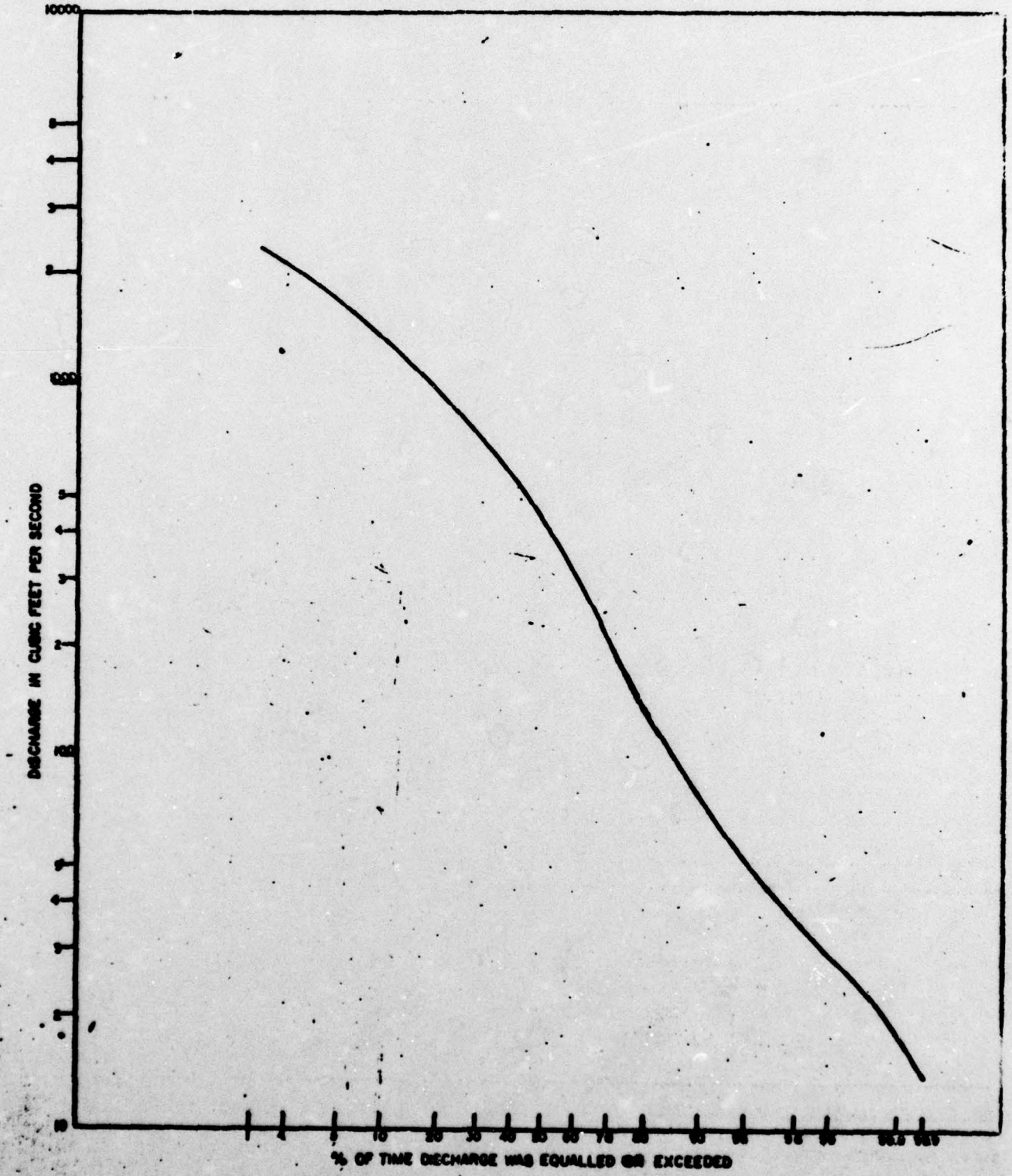
The preceding discussion is based upon an analysis of low flow only. The assumption might become invalid if the high flow regime of the basin is changed significantly. The analysis also does not take into effect the low flow augmentation storage provided in the PL 566 reservoir in the headwaters of the Assabet River in Westborough.

It is noted that this analysis could not be performed for the Sudbury River, which was the area of concern, because no gage exists on the Sudbury River. Accuracy of future studies and projections would be greatly enhanced by the installation of a gaging station on the Sudbury River at or near the Saxonville Dam in North Framingham. The United States Geological Survey has made a preliminary estimate that such a gage would cost $4000 plus $3000 annual operation expense.

Table I

Community	1970 Demand or safe yield (*) MGD	Est 2000 Demand MGD	Demand 1970-2000 MGD	Demand 1970-2000 CFS	1970 Source in or out of basin	Est 2000 Source **	Est 2000 Sewerage	Est. 2000 Sewerage out of basin in excess of 1970 flow MGD
*Acton	1.47	3.54	2.06	3.19	in	out ***	in	
Ashland	1.30	2.63	1.33	2.06	in	in	out	1.33
Bedford	2.06	3.29	1.23	1.90	out	out	out	
Berlin	.15	.82	.67	1.04	in	in	in	
Billerica	4.70	6.81	2.11	3.26	in	in	in	
Bolton	.13	.67	.54	.84	in	in	in	
Boxborough	.10	.82	.72	1.11	in	in	in	
Carlisle	.20	1.49	1.29	2.00	in	in	in	
*Concord	3.54	3.61	.07	.11	in	out	in	
Framingham	8.83	12.57	3.74	5.79	out	out	out	
Hopkinton	.42	1.64	1.22	1.89	in	in	out	1.64
Hudson	1.85	3.45	1.60	2.48	in	in	in	
Lincoln	.53	1.40	.87	1.35	in	out	out	
*Littleton	1.15	1.84	.69	1.06	in	out	in	
*Marlborough ½	N/A	2.71	2.71	4.20	in	out	in	
*Maynard	N/A	1.74	1.75	2.70	in	out	in	
Natick	4.98	6.97	1.99	3.08	in	in	out	1.99
Northborough	.64	2.13	1.49	2.31	in	in	in	
Shrewsbury	1.67	3.50	1.83	2.83	out	out	in	
Southborough	.41	1.46	1.05	1.62	out	out	out	
Stow	..28	.83	.55	.85	in	in	in	
Sudbury	1.22	4.43	3.21	4.97	in	in	in	
Wayland	1.22	4.24	3.02	4.67	in	in	in	
Westborough	1.94	3.05	1.11	1.72	in	in	in	
				57.02				4.96 MGD 7.67 CFS

** out includes MDC
If source is not known, it was assumed to be in basin
*** where safe yields are listed, an "out" source refers to imports in excess of safe yield



CONCORD RIVER BELOW RIVER MEADOW BROOK, AT LOWELL, MASS.

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Appendix F

SUMMARY

Boston Harbor-Eastern Massachusetts Wastewater
Management Study

January 1975

SUMMARY

Boston Harbor-Eastern Massachusetts Metropolitan Area

Wastewater Management Study

January 1975

Foreword

This summary is intended to provide a brief synopsis of the current status of the study. The Technical Subcommittee on Boston Harbor, which is overseeing the study, has reached recommendations about treatment systems for the future wastewater flows of 60 metropolitan area communities. The recommendations reflect a consensus of the agencies on the subcommittee, which has been working together for nearly two and one half years, and a citizens' committee representing a variety of local interests.

Study accomplishments to date include population and employment projections that were used to develop five different wastewater management concepts. After the environmental, social, economic and visual-cultural impacts were analyzed and evaluated, the five concepts were narrowed to specific alternatives from which the recommendations were taken.

The recommendations, needless to say, are not final decisions. They are subject to public review and presentation to Federal, state and local policymakers for further action. In the coming months, the subcommittee will be examining cost allocation and construction priorities as well as institutional arrangements for financing and operating the systems. All this information will be made public.

The January public meetings in Woburn, Needham, Canton and Quincy represent the third set of public presentations about the study. The other meetings were held in November 1973 and May 1974. In addition, there have been informal meetings with local officials as the study progressed.

Agencies represented on the subcommittee are the Metropolitan District Commission (MDC) as chairman, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the Commonwealth's Department of Public Health, Division of Water Pollution Control and Resource Management Policy Council, and the Metropolitan Area Planning Council.

Recommendations

Overview. There are 109 cities and towns in the study area including 43 that are members of the MDC administered Metropolitan Sewerage District (MSD). The subcommittee has endorsed a moderately decentralized treatment system for the MSD. This would be done by maintaining the service area of the Deer Island Sewage Treatment Plant, reducing the service area of the Nut Island Plant, and serving outlying communities with regional treatment plants. The recommended treatment systems encompass 60 communities in the study area.

The recommendations are based on secondary treatment for wastewater discharged into Boston Harbor and advanced treatment at inland plants discharging into rivers. Toxic and highly-polluted industrial wastes will be subject to removal at their sources. Alternative strategies for controlling combined sewer overflows, a major source of pollution in the Boston Harbor drainage area, are being proposed.

The proposed regional wastewater treatment systems are described in the following pages.

Boston Harbor: The present primary treatment plant at Deer Island would be upgraded to secondary treatment to handle anticipated average flows of 380 million gallons per day (mgd) in the year 2000. The Nut Island Treatment Plant would also be expanded and upgraded to handle the anticipated year 2000 average flow of 120 mgd. These facilities are presently designed for 343 mgd and 112 mgd respectively. Sludge produced at the treatment plants would be incinerated, thereby eliminating the discharge of sludge to the harbor. These improvements would benefit overall water quality and help safeguard public health, especially at recreational areas. It should be noted that the restoration of Boston Harbor water quality will depend upon abating several other sources of pollution, particularly the overflows of combined sewers.

Neponset River: An advanced treatment facility would be located in the Canton area. It would treat approximately 30 mgd in the year 2000 and serve Canton, Norwood, Walpole, Sharon and Stoughton. This facility would reduce the service area of the Nut Island plant and keep reclaimed wastewater as far upstream in the Neponset River basin as possible. The highly treated effluent should help improve flow in the Neponset River, especially in dry summer months.

Charles River: An advanced treatment facility would be situated in the Wellesley area to serve the Towns of Wellesley, Framingham, Ashland, Hopkinton, Natick and Southborough and parts of Dover and Sherborn when

local sewer systems are built. This facility would reduce flows to the Nut Island plant by an estimated 30 mgd in the year 2000. The additional flows of clean water to the river will be vital to water quality during dry seasons. Preparations for wastewater treatment systems in the Milford, Medfield and Medway areas are underway in various stages. The elimination of nonpoint and other sources of pollution also will be critical in achieving improved water quality in the Charles River.

Aberjona River: An advanced treatment plant of approximately two mgd in the Woburn area is under consideration to serve the special purpose of increasing flows in the Aberjona River during the summer months. Other means of providing low-flow augmentation for the Aberjona River will be investigated to determine the most cost-effective means of providing the additional flow.

Cost Estimates

The estimated capital costs for these treatment facilities and accompanying interceptors and pumping stations is $735 million. The Federal Water Pollution Control Act Amendments of 1972 (P. L. 92-500) provide 75 percent Federal funding and the state will contribute 15 percent, leaving a local share of 10 percent or $73.5 million. Annual operation and maintenance costs are expected to total $29 million. A breakdown of costs is shown on Table 1. Work is now underway to determine local cost allocations and financing alternatives.

Stream Flow Comparisons

Table 2 offers various flow comparisons in the three rivers. The effluent from the advanced treatment facilities will dominate the rivers at times of extreme low flow. In no case will the facilities cause or aggravate flood conditions significantly.

TABLE I

RECOMMENDED TREATMENT FACILITIES

Location	Average Flow (mgd) yr. 2000	Year 2000 costs ($ millions) Capital, plants, interceptors & pumping stations	Year 2000 costs ($ millions) Operation & Maintenance	Additional Land Area Needed (acres)
Deer Island)	378	523	16	34
Nut Island)	120			19
Canton*	30	79	4.9	25
Wellesley*	30	87	4.9	25
Woburn	2*	*	*	*
Milford	4	4	0.9	4.6
Medway	12	29	1.4	8.5
Medfield	4	13	0.9	4.9
TOTAL		735	29	
Federal & State Grants		661.5	0	
Local Share		73.5	29	

* Under Study

TABLE 2

STREAM FLOW COMPARISON

Recommended Advanced Wastewater Treatment Facility Location	Average Discharge (mgd) (year 2000)	Receiving Stream	Upstream Effluent Discharge (mgd)	10 yr-7 day Low Flow (mgd)	July through October Average Flow (mgd)	Annual Average Flow (mgd)	100 yr Flood Flow (mgd)
Woburn	2	Aberjona River	0	0.25	5	18	790
Canton	30	Neponset River	0	7	40	95	1300
Wellesley	30	Charles River	16	7	80	195	2650

mgd - million gallons per day

Appendix G

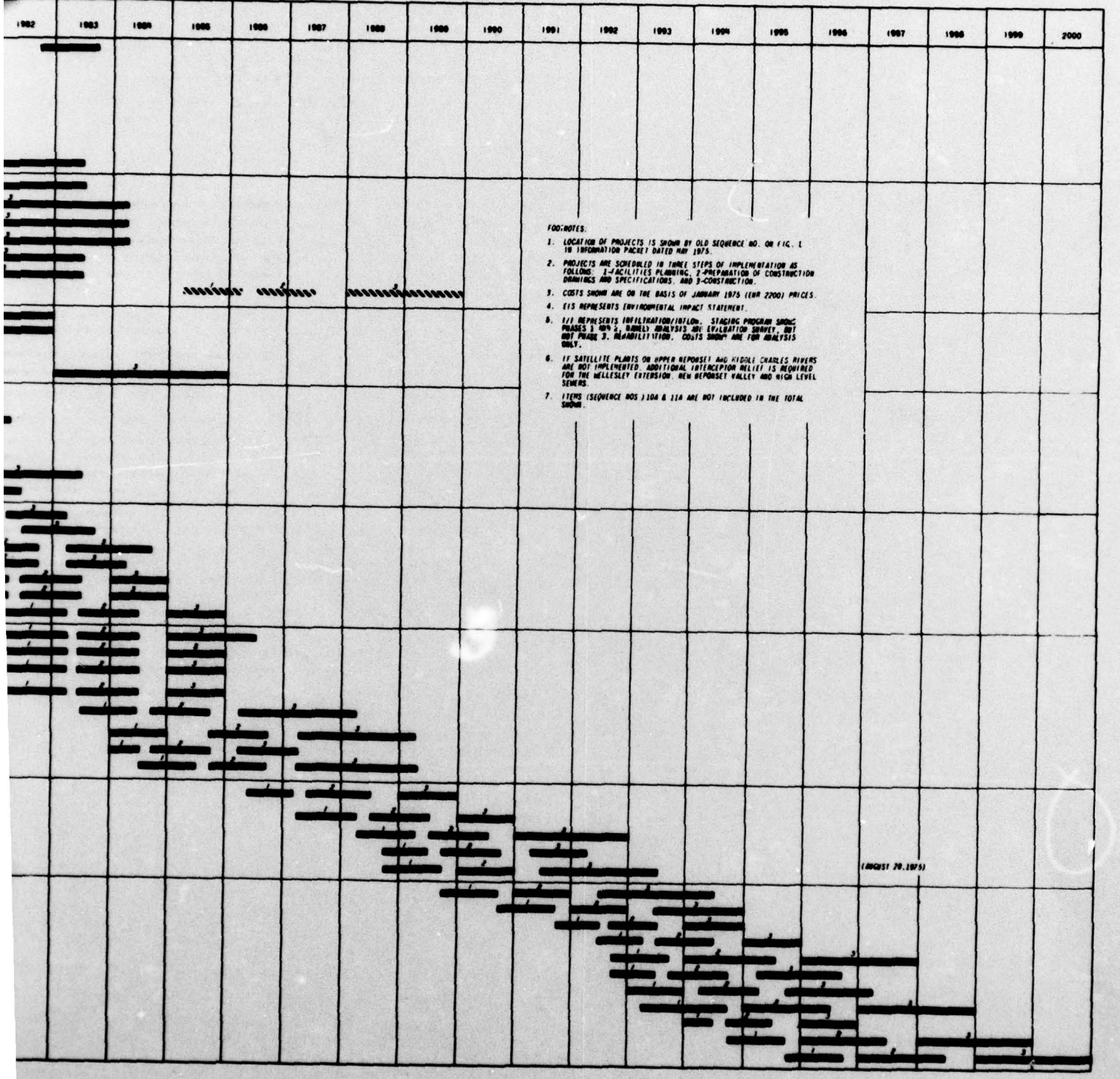
Recommended Construction Staging Program

MDC CONSTRUCTION STAGING PROGRAM FOR WASTEWAT

SEQUENCE NO. NEW	SEQUENCE NO. OLD[1]	DESCRIPTION[2]	SEWER SECTION NO.	COST $ [3]
		AUTHORIZATION BY LEGISLATURE		
		EIS OR MAJOR STUDY PROJECTS[4]		
1	1	SLUDGE MANAGEMENT (PRIMARY)		25,573,000
2	2	I/I ANALYSIS (SOUTH SYSTEM)[5]		983,500
3	14	DORCHESTER BAY COND. S. OVERFLOWS		77,000,000
4	15	I/I ANALYSIS (SOUTH SYSTEM)[5]		1,012,000
5	5 & 6	D.I. PRIMARY EXT. (INCL. OUTFALL)		50,530,000
6	33	D.I. PRIMARY EXP.		41,900,000
7	42	D.I. SECONDARY EXT.		88,700,000
8	43	D.I. SECONDARY EXT.		130,000,000
9	44	SLUDGE MANAGEMENT (SECONDARY)		20,064,000
10	9	MIDDLE CHARLES R. W.W.T.P.		49,600,000
11	4	UPPER NEPONSET R. W.W.T.P.		41,100,000
10A & 11A	-	NORTHBOROUGH RELIEF TO LINE OF (CONCORD SUB.) TO & 11[6]		99,700,000
12	28	CHARLES R. COND. S. OVERFLOWS		84,000,000
13	27	NEPONSET R. COND. S. OVERFLOWS		29,000,000
14	7	FRANKLIN EXT. S.	134, 1390, 132	22,461,000
15	53	LOWER MYSTIC COND. S. OVERFLOWS		88,000,000
16	8	LOWER BRAINTREE COND. S.	125 BRANCH	600,000
17	9	BRAINTREE WEYMOUTH P.S.		2,920,000
18	10	HINGHAM F.M.		534,000
19	11	STOUGHTON EXT. S.	119, 121	1,000,000
20	12	WALPOLE EXT. S.	116, 117, 118	11,004,000
21	13	NO. CHARLES METRO S.	03	1,271,000
22	16	HILLSDALE VALLEY S.	04, 05	5,771,000
23	17	QUINCY P.S. & F.M.		2,220,000
24	18	SOUTH METRO S.	17	1,165,000
25	19	CHELSEA BRANCH S.	51	145,000
26	20	STONEHAM EXT. S.	51	340,500
27	21	STONEHAM TRUNK S.	42	145,000
28	22	EAST BOSTON STEAM P.S.		1,000,000
29	23	CHARLESTOWN P.S.		8,000,000
30	24	ALEWIFE BROOK P.S.		712,000
31	25	EAST BOSTON ELECTRIC P.S.		956,000
32	26	HOUGHS NECK P.S.		293,000
33	29	SPRINGFIELD MEDFORD BRANCH S.	35	4,500,000
34	30	SOUTH CHARLES REL. S.	46, 49	2,676,000
35	31	WAKEFIELD BRANCH S.	50-00, 00-49, 50-49	850,000
36	32	SOUTH CHARLES RIVER S.	56, 58	8,420,000
37	34	CUMMINGSVILLE BRANCH S.	47-00	1,012,000
38	35	HINGHAM P.S.		800,000
39	36	REVERE EXT. S.	57A, 62	3,413,000
40	37	LYNNFIELD EXT. S.		387,000
41	38	ARLAND-ASPINWALL EXT. S.		4,400,000
42	39	WESTON-LINCOLN EXT. S.		3,032,000
43	40	SOUTHBORO EXT. S.		2,421,000
44	41	SHARON EXT. S.		1,210,000
45	45	STONEHAM EXT. S.	119, 120, 121	827,000
46	46	WILMINGTON EXT. S.	00, 00	2,054,000
47	47	SOUTH METRO S.	46.5, 47, 132	675,000
48	48	WESTWOOD EXT. S.	135, 138	2,350,000
49	49	WAKEFIELD TRUNK S.	00-41, 00-41, 47, 49	6,756,000
50	50	WAKEFIELD BRANCH S.	00-00	177,000
51	51	SO. CHARLES RELIEF S.	49, 46, 47, 51, 57	2,041,000
52	52	SO. CHARLES RIVER S.	00	6,200,000
		TOTAL		000,000,000[7]

1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986

NG PROGRAM FOR WASTEWATER MANAGEMENT PROJECTS



FOOTNOTES:

1. LOCATION OF PROJECTS IS SHOWN BY OLD SEQUENCE NO. ON FIG. 1 IN INFORMATION PACKET DATED MAY 1975.
2. PROJECTS ARE SCHEDULED IN THREE STEPS OF IMPLEMENTATION AS FOLLOWS: 1-FACILITIES PLANNING, 2-PREPARATION OF CONSTRUCTION DRAWINGS AND SPECIFICATIONS, AND 3-CONSTRUCTION.
3. COSTS SHOWN ARE ON THE BASIS OF JANUARY 1975 (ENR 2200) PRICES.
4. EIS REPRESENTS ENVIRONMENTAL IMPACT STATEMENT.
5. I/I REPRESENTS INFILTRATION/INFLOW. STAGING PROGRAM SHOWS PHASES 1 AND 2, BASELY ANALYSIS AND EVALUATION SURVEY, BUT NOT PHASE 3, FEASIBILITY/DESIGN. COSTS SHOWN ARE FOR ANALYSIS ONLY.
6. IF SATELLITE PLANTS ON UPPER NEPONSET AND MIDDLE CHARLES RIVERS ARE NOT IMPLEMENTED, ADDITIONAL INTERCEPTOR RELIEF IS REQUIRED FOR THE WELLESLEY EXTENSION, NEW NEPONSET VALLEY AND HIGH LEVEL SEWERS.
7. ITEMS (SEQUENCE NOS.) 10A & 11A ARE NOT INCLUDED IN THE TOTAL SHOWN.

(AUGUST 20, 1975)

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